Online formative MCQs to supplement traditional teaching: a very significant positive impact on student performance in the short and long run

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Abstract

The paper builds on the research underpinning *One Lecturer's Experience of Blending E-learning with Traditional Teaching* (Catley, 2005). It analyses the earlier findings in more depth and examines the longer term impact of online quizzes on student performance. Engagement with formative online MCQs is explored generally and the links between MCQ engagement and a range of student characteristics: seminar attendance, "A" level performance, age, nationality, gender and prior study of the discipline are analysed. The relative impact on performance of online formative quiz taking in one 15 credit first year module is compared to the impact of these other characteristics at modular, year and degree level. The case study involves in total 897 students, with particular focus on the results of one year's results (n=201). Analysis of the data for this year found the A level grades of those who engaged with the formative MCQs were identical to those who did not engage. However, the research identified certain groups as more likely to make use of the online support: namely mature students, international students and non-A level entry students. Students who took the

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online quizzes offered in the first year module performed better in the module, in the first year of their studies and over the degree as a whole. The conclusion is that engagement with online formative MCQs had a very significant impact on performance: an impact that was more significant than that for any other variable: being nearly twice as significant as seminar attendance and five times more significant than prior qualifications.

Background

The original article (Catley, 2005) focused on the impact of online quizzes on the performance of students on Legal Method: a compulsory law module undertaken by all undergraduate law students in the first term of their first year at Oxford Brookes University. The course was central to their future law studies providing the building blocks on which that study is based. In particular the course focused on developing a lawyer-like way of thinking, through assisting students in reading, understanding and applying case law and statutes.

A comment on the figures

The original article considered the performance of all students taking the module. Subsequently the data was re-assessed excluding students who were re-taking the module. The reasons for excluding these students were multiple. For example, if they had failed and had no medical or other extenuating circumstances they would have been capped to a maximum mark of 40%. Whilst the data used originally had incorporated these students' actual marks rather than their capped marks, the demotivating

impact of knowing that your mark is capped meant that these results should probably have been excluded. Additionally, if they had progressed to year two they would probably be taking a full complement of second year modules at the same time as retaking Legal Method. The tiny number of students registered for the module, who submitted no assessed work have also been excluded. The exclusion of these students had only a very small impact on the overall figures, largely because the number of re-taking students and registered, but non-active students was very small. However, their exclusion, arguably, gives a more accurate assessment of the impact of the introduction of the online quizzes.

The Perceived Problem

The module teaching team were aware that the results could be better. The results for 1999-2000 and 2000-2001 were typical of the situation before the introduction of any online elements into the course.

Chart 1

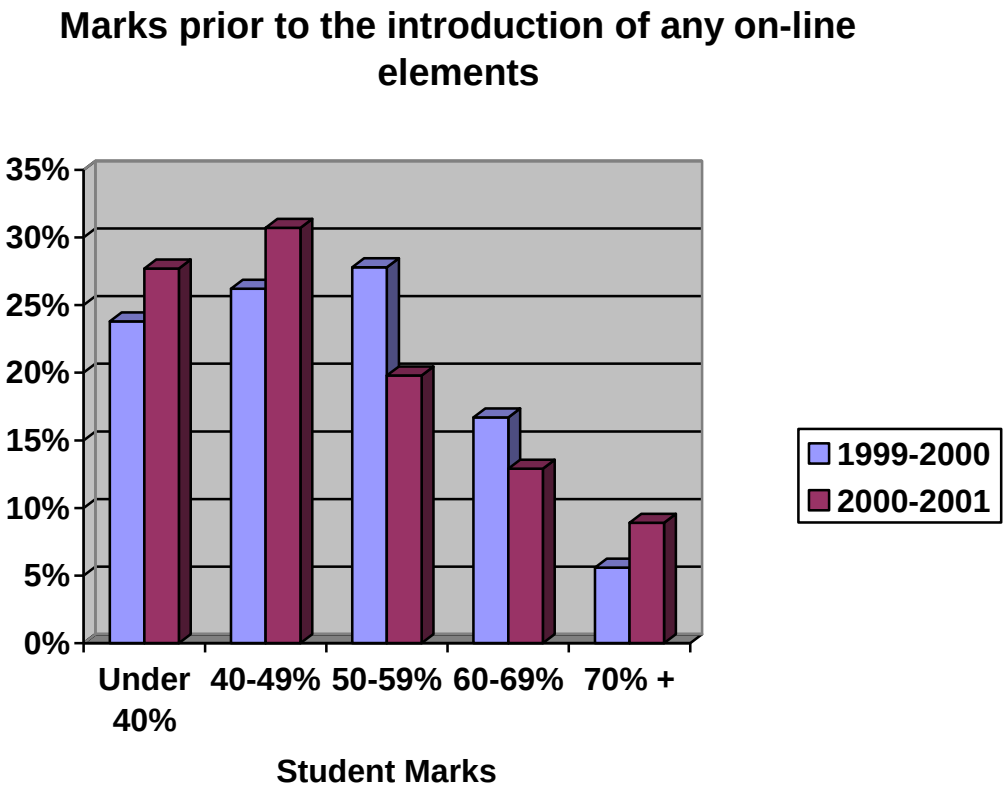


Table 1 - Marks prior to the introduction of any online elements

Legal Method Results 1999-2000 and 2000-2001						
	1999-2000		2000-2001		*Aggregate results 1999-2001*	
Mark Grouping	Number of students	Percentage of cohort in each mark grouping	Number of students	Percentage of cohort in each mark grouping	*Number of students*	*Percentage of cohort in each mark grouping*
70% +	7	5.6%	9	8.9%	*16*	*7.0%*
60 - 69%	21	16.7%	13	12.9%	*34*	*15.0%*
50 - 59%	35	27.8%	20	19.8%	*55*	*24.2%*
40 - 49%	33	26.2%	31	30.7%	*64*	*28.2%*
Under 40%	30	23.8%	28	27.7%	*58*	*25.6%*
Size of cohort	126		101		*227*	

The results for both years were broadly in line - approximately 25% of the students failed to reach the pass mark of 40%, a similar percentage got marks in the 40s. Fewer than 25% achieved marks of 60%+, with considerably fewer than 10% gaining marks of 70%+. If one wished to put a positive gloss on the figures then around 75% passed at first attempt, and of the remaining 25% many passed the re-sit - the overall pass rate after the re-sit was around 85%. However, this interpretation conceals several issues.

Firstly although the pass rate for those re-sitting was quite good (63% in 2000-01), not all students offered re-sits took up the opportunity to re-sit and not all students were eligible to re-sit. Secondly the re-sit exam was under the university modular scheme scheduled for the Saturday of the third week of the following term. This meant that students, who had struggled in term one, had in addition to their term two studies to prepare for the re-sit exam. Perhaps even more importantly, as stated above, the knowledge acquired in Legal Method is central to the students' future legal studies. Therefore the hope would be that all students would acquire a sound basis for their future studies - the results indicated that not only were 25% not achieving sufficient understanding to pass at first attempt, but that less than 25% were achieving a very good understanding - assuming that such a level of understanding was reflected by a mark of 60% and above.

Linked to this, the tutors were trying to impress on the students that if they wanted to pursue a career in the legal professions they would have to perform well in their law degree. Tutors were explaining that each year there

were approximately twice as many law graduates as there were training places to become solicitors and barristers and that as a consequence their final degree classification was likely to be critical in the selection process and that if they wanted to enter the profession (as most did at the start of their studies) then they should be aiming for an upper second class honours degree or better (i.e. a graduating average of 60% and above). This advice was felt necessary so that students appreciated that if they were to enter the profession they needed to do more than just pass. However, with less than 25% of students achieving this 60% target in Legal Method, the risk was that many would feel dispirited at an early point of their legal studies.

Possible reasons for poor performance

There were a number of explanations for the low marks. Many of these reasons would apply not just to this particular module but to virtually all first year courses at virtually all universities. Many students were away from home for the first time. Some were homesick. Some were enjoying the opportunities afforded by their new found freedom. Some were forced to seek paid employment in order to fund their studies. Some were studying in a foreign country and possibly not in their first language.

Some of the reasons stemmed from the fact that Law is one of a number of undergraduate courses where typically most students have never studied the subject prior to university and therefore do not know what is expected of them. Of the 2003-04 cohort only 44 out of 201 (21.9%) had studied Law at A-level or AS-level. Ten years later, the percentage of law undergraduates

to have taken law prior to university will typically be higher, but is still likely at most institutions to be a minority.

Other reasons were peculiar to the Brookes' modular scheme. The modular structure at this time was that each single module was worth 15 credits and ran for 8 teaching weeks. There was then one week for revision followed by one week for exams. The whole Legal Method module was therefore completed before Christmas. The module was assessed by a coursework exercise and an exam (75% exam, 25% coursework). In order to allow students sufficient time to reflect on the feedback for the coursework, the course team considered that the coursework had to be returned by week 7 - this meant that, in order to allow time for marking, the coursework had to be submitted in week 5. Therefore students who had never studied law before were submitting coursework on which 25% of their marks would rest after only five weeks and were sitting the exam in their tenth week at university. Given the distractions of university life and the conflicting pressures on their time it was perhaps a major achievement that around 75% of students were passing the module at first attempt. Nevertheless, the aim of the changes was to improve that rate without making the course academically less rigorous.

Considering change

As previously stated, Legal Method is a skills based module aimed at developing a lawyer-like way of approaching legal problems and handling legal materials. The course content reflected this and the course team and

colleagues teaching other first year law modules agreed that the course content should not be changed.

Similarly the assessment was felt appropriate. Students were assessed on statutory interpretation in the coursework exercise. The examination was split into Section A consisting of ten short questions testing their knowledge of the material covered in the lectures and Section B in which about six questions were asked on a case report supplied to students in the final lecture. All questions in the examination were compulsory as it was felt that students should have developed all the knowledge and skills covered in the course and should not think that they could omit some parts from their revision. In addition the course was assessed by means of a library exercise testing their ability to retrieve paper and electronic resources. The library exercise was assessed on a pass/fail basis.

The module was taught by a mixture of lectures and seminars. Each student had two hours of lectures on the module each week and one hour of seminars. The seminars provided the main opportunity for students to develop the skills involved in reading, understanding and applying case law and statutes. Average seminar group size was, assuming full attendance, around 15. Resource constraints meant that is was not feasible to reduce teaching group sizes or offer additional class contact.

In addition to lectures and seminars, students were also provided with a Skills Booklet which gave guidance as to the assessment criteria that would

be used and detailed the skills that students were expected to develop during the module. The Skills Booklet also contained details of past assessment exercises together with examples of good and bad answers with explanations as to why certain answers were better than others.

Whilst the teaching team considered that students should have been well prepared for the assessment, a recurrent feature of end of module student feedback was that a minority of students wished they had been better prepared.

The first change

This was done for the 2001-02 cohort. The guidance covered both the coursework and the examination. The online coursework guidance was based on the previous year's coursework exercise. The approach adopted was, looking back, hardly sophisticated! Students were shown on screen an extract from a statute and an accompanying question. They were then asked to work out their answer and write it down. Once they had done this they were instructed to click "next". This took them to a screen which detailed the issues that they should have covered. Again they were given the opportunity of clicking "next" when they had read through this guidance. This linked to the marking criteria. It was then suggested that they use this to assess their earlier written answer. Students were then given the opportunity to consider three more coursework questions - all following the same procedure.

The exam guidance followed a similar approach and was based on the previous year's exam. Instead of the three stage approach adopted for the coursework - (1) question, (2) guidance, (3) mark scheme - the exam guidance followed a two stage approach - (1) question, (2) mark scheme. This slightly amended scheme was adopted because it was felt that with 10 Section A questions and 6 Section B questions student might tire of the three stage approach and prefer a two stage approach. The system was very low tech in that they were not writing their answers online and they had to mark themselves rather than receiving automated feedback and marks.

However, this approach of self-marking could be argued to be preferable in that it encouraged self assessment and enabled students to engage with and reflect on the assessment criteria (Boud, 2013). However, it was not known who had visited the site and whether once there they had followed the instructions and completed the task. Students were asked, in the end of term feedback, whether they had used it for the coursework exercise. 42% of respondents (70% response rate) stated that they had done so and of these 86% said that they considered that it had been valuable. As the feedback was collected in the final lecture it was not possible to gauge whether the exam guidance would be used or whether it would be found to be of use. A question was asked as to whether students intended to make use of the online guidance relating to the examination before they sat the exam. 100% of respondents said that they intended to make use of the guidance. There are various possible explanations for this response: were students simply responding in the manner they thought the module leader

wanted (but if so, why did only 42% report using the coursework guidance), were they expressing their true intent or was it more a case of wishful thinking. As the end of module questionnaire was anonymous and as there was no follow up survey the true meaning of the unanimous response will remain unknown.

The impact of the first change

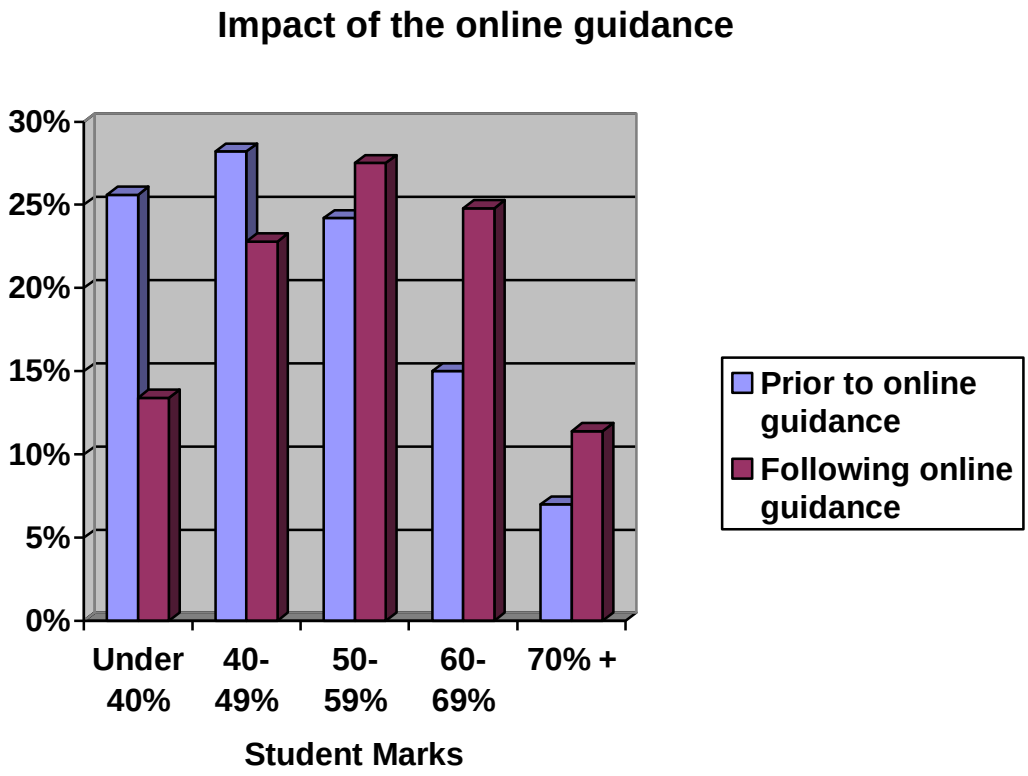
The results for 2001-02 showed a marked improvement.

Table 2

Results before and after the introduction of online guidance

	Aggregate results 1999-2001 (before the introduction of online guidance)		Results 2001-2002 (after the introduction of online guidance)	
Mark Grouping	Number of students	Percentage of cohort in each mark grouping	Number of students	Percentage of cohort in each mark grouping
70% +	16	7.0%	17	11.4%
60 - 69%	34	15.0%	37	24.8%
50 - 59%	55	24.2%	41	27.5%
40 - 49%	64	28.2%	34	22.8%
Under 40%	58	25.6%	20	13.4%
Size of cohort	227		149	

Chart 2



As Chart 2 shows the distribution of marks after the introduction of online guidance became much closer to a classic bell curve distribution - more results fell into the 50-59% category than any of the other groupings, roughly equivalent numbers got marks in the 60s as in the 40s and similarly the number gaining marks of 70% and above was broadly in line with the number getting marks of under 40%. This was a very different shaped curve to that achieved in the two previous years which had seen most of the students getting under 50% and hardly any getting marks in excess of 70%.

The improved results were also reflected in the improvement in average marks.

Table 3

Average mark before and after the introduction of online guidance

Year	Number of students	Average Mark
No online guidance		
1999-2000	126	48.18%
2000-2001	101	46.27%
Combined 1999-2001	*227*	*47.33%*
Introduction of online guidance		
2001-2002	149	53.64%

Table 3 shows that in 2001-02 the average mark rose by more than 6.3% from the average of the two previous years. Table 4 examines the impact on the coursework and examination marks.

Table 4

Average marks for coursework and examination before and after the introduction of online guidance

	1999-2001	2001-2002	Difference between 2001-02 results and 1999-2001 results
Number of students	227	149	
Average Coursework mark (out of 25)	12.51	13.54	+ 1.03
Average coursework mark expressed as a percentage	50.02%	54.16%	+ 4.14%
Average exam mark (out of 75)	34.83	40.11	+ 5.28
Average exam mark expressed as a percentage	46.44%	53.48%	+ 7.04%

Table 4 shows that the average mark for both the coursework and the exam increased after the introduction of online guidance. Interestingly most of the improved performance relates to improved exam performance. Average marks for the coursework rose by just over one mark, whereas average marks for the exam increased by more than five marks. This is partly explained by the greater weighting given to the exam, 75% as against 25%. However, even allowing for this if one looks at the improvement in terms of the percentage of marks available for each part then in percentage terms the 7% improvement in exam performance exceeded the 4.1% improvement in coursework performance.

Cause or coincidence?

The introduction of online guidance had coincided with a fairly dramatic improvement in the marks. Other course elements had remained unchanged and yet it was not possible to prove a causal link between the online guidance and the improved performance. The system providing guidance did not enable those students who accessed the site to be identified, indeed it did not even monitor whether anyone accessed the site at all. The end of course feedback suggested that a significant minority had accessed the coursework guidance and found it useful. As this feedback was anonymous it was not possible to examine whether those using the guidance had outperformed those who had not. The same feedback also suggested that every respondent intended to look at the guidance before the exam. It was impossible to know whether they had in fact done so.

Aside from the introduction of the online guidance, the course had not changed in 2001 from the course that had been run over the previous two years. The same lecturer continued to deliver all the lectures and the lecture content remained unchanged. Similarly the seminars remained unchanged as did the assessment scheme. Entry requirements for the course were unaltered and the recommended course textbook was unchanged. Obviously the questions asked in the coursework and exam did vary, but the aim was to retain a comparable level of difficulty. Therefore the only apparent change was the introduction of the online coursework and exam

guidance. There was a strong suspicion that the introduction of the online guidance had led to better results. However, there was no evidence that the change was not simply a one-off occurrence which would not be sustained. Similarly there was no evidence that those who had done better were those who had accessed and utilised the guidance.

The improved performance needed to be investigated. However, in view of the scepticism expressed in some quarters about the effectiveness of e-learning, it seemed advisable to investigate this scepticism as well as assessing the drivers behind the growth of online learning.

Context: reviewing the literature of the time

The second half of the twentieth century heralded the advent of mass higher education in the United Kingdom. Dearing noted that the number of students in higher education had over the previous twenty years *"much more than doubled"* whilst the *"unit of funding per student has fallen by 40 per cent"* (NCIHE,1997: summary report - para. 14). As Lindsay and Breen commented

> *"massification of HE simultaneously increased student: staff ratios requiring recruitment from further down the population ability curve. Universities were forced to reduce lecturer input per student just as there was an increase in the input needed by the average student to maintain existing standards."* (2000: 9)

As universities have looked for means to bridge the funding shortfall this has led to additional pressures on teaching staff including pressure to publish fuelled by the Research Assessment Exercise and now the Research Excellence Framework, pressure to act as consultants and pressure to develop so-called full-cost courses. In this new world there has been a danger that the undergraduate degree which remains the core business for most universities becomes the forgotten Cinderella starved of resources and attention. Even the introduction of £9,000 per year fees does not seem to have transformed the undergraduate degree from its Cinderella status. Adverts for academic posts, even outside the research intensive universities, still typically focus on research rather than teaching. The apparent ability to produce 3* and 4* publications and attract research income is typically given much more prominence in recruitment and promotion decisions than the ability to deliver successful undergraduate courses and achieve high National Student Survey results.

Changes in secondary schooling have arguably exacerbated this position. Preoccupation with league tables has led schools to place great emphasis on assisting their students to do as well as possible. Changes in assessment at GCSE and A-level have led to students arriving at university with less experience of the approaches to teaching and assessment adopted in subjects such as law at university. As an anonymous Head of a University Law Department said:

> *"Students do modular 'A' levels now and they are not used to studying for a year and taking a three hour exam. That culture is*

gone. You hit students with that kind of thing these days and it has a massive impact on them. They are not used to doing it. It's not that they are not as bright, they are, but they are being skilled differently at school and we have to appreciate that." (Clegg, 2004: 30)

This change is also borne out by Bermingham and Hodgson when they note that:

"students entering higher education, at least in the subject of law, experience a culture shock as they move from a system where previously they were given regular feedback on essays and encouraged to submit drafts of coursework assignments for formative comments, to an environment where they are largely left to their own devices, and with contact time dropping from 20 (or more) hours to less than ten." (2006: 153)

This pressure on resources appears to apply across the sector. Clegg (2004) in her review of undergraduate law teaching at a selection of different universities noted that resources were considered a problem for all the departments. Bermingham and Hodgson's assessment of current contact time appears in line with Harris and Beinart's larger survey of law schools (2005) which found 77% of qualifying[2] law degree courses involved students in attendance at less than 10 hours of lectures per week.

This pressure on resources has also meant a general decline in the quantity of feedback provided for students (Higgins et. al., 2002). This paucity of formative feedback has also been witnessed in undergraduate law teaching

[2] A qualifying law degree course is one that satisfies the Law Society and Bar Council's requirements as an appropriate training for a student wishing to become a solicitor or a barrister. The vast majority of law degree courses have this status.

(Bermingham & Hodgson, 2005; Bone, 2006). The picture is not however unique to the United Kingdom, Peat (2000) writing about the Australian experience notes the pressure of increasing student numbers and declining resources and comments that in such a context formative feedback is seen as expensive and expendable. It is also interesting to note that British academics' concerns that school students are ill prepared for university with its focus on independent higher level learning are mirrored by Peat's view of first year biology students at the University of Sydney: *"many students have an expectation of being spoonfed, a residue of a high school surface approach to learning"* (2000: 2).

To summarise higher education in the early twenty first century faces a multiplicity of problems: increased student numbers have been combined with reduced resources per student, a position which changed briefly with the introduction of higher fees in 2012, though the extent to which such improved income streams have been directed towards undergraduate law teaching is perhaps questionable in many universities. A more diverse student body, drawing in students who would previously not have gone to university and who probably have greater need of academic support, can expect less class contact as teaching staff are diverted into other activities to attempt to address the funding shortfall. Students who have emerged from increasingly supportive school environments arrive at university to find that previous support mechanisms such as formative feedback on practice essays are now rarely available. The result seems likely to be that more

students will fail or that standards will fall unless a low cost solution can be found.

E-learning to the rescue?

Lord Dearing's National Committee of Inquiry into Higher Education was of the view that "… C&IT[3] will have a central role in maintaining the quality of higher education in an era when there are likely to be continuing pressures on costs and a need to respond to an increasing demand for places in institutions." (NCIHE, 1997: para. 13.2) Universities appear to have acted upon Dearing's advice. Jenkins et. al. (2001) noted that, just four years after Dearing, 80% of the 70 higher education institutions surveyed ran a Virtual Learning Environment ("VLE") for their students. It is likely that if that survey were to be repeated today the figure would be 100%. This interest in e-learning is not entirely new. Whilst Gibbs and Jenkins' seminal work *Teaching Large Classes in Higher Education: How to Maintain Quality with Reduced Resources* (1992) made no mention of it, Graham Gibbs' subsequent work *Improving Student Learning through Assessment and Evaluation* (1995) did include consideration of the educational effectiveness of computer-based learning. Prior to 1995 computer based learning may not have been the norm but it did exist, for example Wang et. al. (2004) citing Bork (1981) trace references to computer based teaching in science back to the 1970s. The primary driver for the expansion of e-learning in the late 1990s appears to have been the belief that it could provide a quick fix (McArthur & Lewis, 2001).

[3] Communications and Information Technology.

The change also links to a perception that students are changing. Lindsay & Breen see computers as having "become part of a learning support triarchy with teachers and books as the other two elements" (2000: 10). This view that today's students use computers and the internet so routinely outside the university context has led Gipps to suggest that students "using mainly paper-and-pencil approaches within education makes the formal learning setting seem anachronistic." (2005: 174). Mackie (2006) has charted the way in which computers have become a part not only of the student's every day life, but also part of the school student's school life from researching coursework via Google and Wikipedia to revising by means of sites such as GCSE Bitesize, Sam Learning, Exams Tutor, S-Cool! and Tutor2U. This new style learner has been termed "Homo Zappiens" by Veen (2003, 2005) who views the changes as being educationally more significant than the normal changes from generation to generation.

There is a considerable body of support for the incorporation of e-learning into higher education generally (Laurillard, 1993) and into law teaching more specifically (Migdal & Cartwright, 2000). However, this support, together with the changes in students' approaches to learning, has not been met by wholesale changes in teaching methods. Although class contact may have fallen (Bermingham & Hodgson, 2005), the basic approach to university law teaching has according to Clegg (2004) remains the tried and trusted model of lectures, seminars and tutorials.

There has been a growth of purely or primarily online courses, but these have tended to be restricted to students studying by means of distance learning (Bates, 2005) and this approach has tended to be reserved for courses aimed at students studying part-time whilst working full-time. Generally such courses have also been dogged by low completion rates (Brennan, 2003). Massive open online courses have been particularly dogged by poor completion rates (Breslow et. al., 2013; Jordan, 2014; Simpson, 2012, 2013). This may be explained by students feeling a sense of isolation without the face to face communication provided in the traditional classroom setting (March, 1995) and difficulties in discussing and developing ideas online (Duffy et. al, 1998). Low completion rates may also stem from technological problems (Kerka, 1996) which may themselves link into problems of sustaining student motivation in an online environment (Muilenberg & Zane, 2005). These problems may explain why purely or primarily online courses have rarely been offered to full-time undergraduate students studying at university. In addition they run counter to the student expectation that higher education will involve classes and face to face dialogue with staff and with their fellow students.

However, Clegg (2004) notes that, whilst some law lecturers were enthusiastic about incorporating e-learning into their teaching, the majority were not. These findings mirror other accounts such as that of Challis & Lidgey who bemoaned staff reluctance “to convert existing learning resource material into electronic form”, explaining it in terms not only of staff having insufficient time and technical expertise, but also citing technophobia and a

failure on the part of staff to perceive any benefit in the change. Challis & Lidgey's conclusion was that e-learning action plans "must address these blocks and find a way to overcome them." (2000: 6). Schoepp's findings (2005) reinforce the view that uncertainty as to how best to integrate technology and lack of technical and pedagogic support are significant barriers to the more widespread adoption of e-learning techniques.

Evidential support for e-learning?

Staff failure to embrace e-learning may be well grounded. Even if they did have sufficient time and expertise would more online learning enhance the courses taught?

Russell's review (1999) of 355 research projects suggests that in terms of student performance there is very often no statistically significant difference between how courses are taught. However, his investigation (covering the period 1928 - 1998) largely predates the growth of computer based learning and of the 355 projects examined only 40 of the studies cover computer based instruction. Since the publication of Russell's book more investigations have been published many of which support his basic premise that "[t]here is nothing inherent in the technology that elicits improvements in learning (1999: xiii). Many of these can be accessed on the self-styled "no significant difference phenomenon website".[4] In addition to

[4] "The no significant difference website" is hosted by the Western Cooperative for Educational Telecommunications ("WCET") and is accessible at: http://nosignificantdifference.org/ . In addition to promoting Russell's book it also includes numerous articles on the impact or otherwise of different teaching approaches.

work referred to on that site, there is further research which supports the contention that the method of delivery does not affect student performance. Ryan (2001, 2002) found no significant difference in terms of final course grades between students taught in traditional lecture based classes and those taught by means of distance learning whether by means of a web-based course or a telecourse. Schutte's findings (1997, 1998) that students performed on average 20% better on an online course were not replicated by Jones (1999) when he attempted the same experiment. On the other hand not all research indicates that the approach adopted had no impact, for example Radhakrishnan & Bailey (1997) found that a web-based approach led to better results than a classroom based approach. However, it is important to note that the primary focus of Russell (1999) and that of Ryan and of Radhakrishnan & Bailey was on the impact or otherwise of distance education as against traditional face-to-face instruction and that they were therefore not examining the impact of e-learning as a supplement to traditional teaching approaches.

Some investigations have suggested that including course materials online to support traditional teaching methods can improve student performance. Hellweg et. al. (1996) found that student pass rates improved when course-related material was made available online as well as through traditional means. Pearson & Trinidad noted, based on previous work in which Trinidad had been involved (Aldridge et al, 2003; Trinidad et al 2001), that student retention and achievement could be improved in an "outcomes focussed and technology-rich learning environment" (2005: 396). However, Pearson &

Trinidad's assessment of the effectiveness of the online learning activities when they subsequently trialled them at the University of Hong Kong does indicate some problems: "student comments about 'too much information', 'too many online forums' and the content of the module being 'out of touch'." (2005: 397) Given that the students in question were part-time students studying for a Masters in Information Technology in Education one might have anticipated that they would be very ready to embrace e-learning initiatives; the fact that there were problems is disturbing. The paper explains how these problems were tackled, but in many ways the account appears to support the need for close monitoring of courses and the need to be outcome focussed rather than supporting the inherent merits of e-learning as a supplemental tool. Notwithstanding research such as that of Hellweg et. al. and Pearson & Trinidad, there appears to still be considerable justification for Coates & Humphreys' comment that:

> "Little is known about the effectiveness of these web-based supplements to face-to-face instruction. How intensively will students utilize online course materials? Does access to online course materials increase student comprehension and retention? Despite the paucity of answers to these and similar questions the rush to make online technologies an important component of higher education continues." (2001: 133)

Searching for a model that works.

The lecturer who decides to embrace e-learning faces a choice of methods to adopt. The Dearing Report, when advocating e-learning was not

specific as to what should be done. It was simply stated that "C&IT[5] will have a central role in maintaining the quality of higher education in an era when there are likely to be continuing pressures on costs and a need to respond to an increasing demand for places in institutions." (NCIHE, 1997: para. 13.2).[6] Cliff Allan, Director of Programmes for the Higher Education Academy, in his foreword to the 2005 HEFCE strategy for e-learning wrote about the need to "carry forward strategies based on evidence of what works" (HEFCE, 2005a: 1). Elsewhere the strategy document talks about "embedding e-learning appropriately, using technology to transform higher education into a more student-focused and flexible system" and meeting "the needs of learners and their own aspirations for development" (HEFCE, 2005a: 5). However, whilst the strategy recognises the need to base developments on "what works" the policy document does not provide answers as to what does and does not work.

Online quizzes / formative tests

The idea of using online formative tests or quizzes is well established (Byrnes et. al., 1995; Carbone & Schendzielorz, 1997; Hammer & Henderson 1972). However, the ease of introduction is now much easier with almost all VLEs providing this facility. The potential of online multiple choice questions (MCQs) is also well documented (Bailey et. al., 2001; Bonham et. al., 2000; Bower, 2005; Buchanan, 2000; Dalziel & Gazzard 1998, 1999; Khan et. al., 2001). Some of the benefits include improved student performance by those who score well in quizzes (Bailey et. al.,

[5] Communications and Information Technology.
[6] For a discussion of this quotation see page 19 above.

2001), the value of timely and immediate feedback (Brass & Pilven, 1999; Dalziel, 2001; Hammer & Henderson, 1972; Mazzolini, 1999) and linked to this the benefit for students of easy access coupled with the ability to monitor personal progress (MacDougall et. al. 1998). In the circumstances it is perhaps not surprising that online MCQs have received positive feedback from students (Hammer & Henderson, 1972) and are perceived by students to be a valuable educational tool (Hester, 1999). Online quizzes also provide valuable information for tutors (Mazzolini, 1999) in that the tutor can discover how many and which students are taking the quizzes, how well each student is performing and how well students are doing on particular questions.

Online MCQs appeared to me to be a useful supplement to the existing course. The system available at Brookes at the time of introduction offered the facility to set questions in six different MCQ formats. The question setter could determine when the questions would become available and when they would cease to be available, which mark would be recorded, if any, for example the first, the highest or the last, how many attempts students would be given and also provided the facility to provide feedback tailored to the particular answer chosen. Whilst not experienced in setting MCQs the technology itself proved easy to use and the main difficulty I found was in finding suitable “wrong” answers and precisely wording questions so that only one answer was correct. Additionally designing feedback for wrong answers that would provide pointers to the correct answer, but would not give it away was also surprisingly time consuming. In this my experience

supported Ruzic's finding (2000) that the creation of e-learning materials is usually very time consuming.

I chose to create a quiz for each of the eight lectures, these would become available online immediately after the lecture and would remain available throughout the duration of the module. In this way they would provide an opportunity for students to test whether they had understood the material covered in the lecture. Additionally or alternatively they could be used as a revision aid. I also produced a ninth quiz testing student understanding of some of the legal abbreviations used during the lecture series; this quiz became available at the end of the course. Whilst the exam and the coursework contained no MCQs, one element of the exam[7] tested knowledge of the material covered in the lectures by means of ten short questions each of which was worth three marks. Therefore the material covered in the quizzes was potentially, though not necessarily, relevant to one element of their final assessment. Accepting the Hedberg & Corrent argument that "assessment drives learning" (2000: 83), but not wanting to change the assessment methods for the module, this appeared a good compromise. Students would hopefully see a reason for attempting the quizzes and the knowledge they developed would prove useful in their subsequent assessment. This aim was hopefully not unrealistic: Ellis (2000) and Gluck et. al. (1998) both found that students welcome the idea of computer based learning being offered as a supplement to traditional teaching approaches.

[7] Section A – worth 30% of the total marks for the module.

One worry I had about the use of online materials related to their accessibility for students with special educational needs. However, reassurances from those involved in maintaining Brookes' WebCT provision indicated that adaptations were in place to enable all our students to access and use the online materials. Further the work of Kiser (2001) and particularly that of Slem & Kane (2001) which indicated that students with known or suspected learning disabilities found Web resources particularly useful and used them more heavily than other students, suggested that far from disadvantaging such students, the online materials might provide particularly effective support for such students. More recently Seale (2006) has set out detailed guidance as to good practice in terms of eliminating barriers and producing e-learning materials that are accessible for all.

Assessing the impact

One issue on which there was a paucity of information was whether the introduction of online materials would lead to better student performance. Whilst there were guides to good practice (Bates, 1995; Salmon, 2000;), there was a distinct shortage of material as to how many students could be expected to engage with e-learning materials or on whether particular types of students would be more likely to engage. Since introducing online testing a glut of further guides to best practice have been produced (including: Bates, 2005; Billings, 2004; Brennan, 2003; Clarke, 2004; Essom, 2005; Garrison & Anderson, 2003; Hills, 2004; Jochems et. al. 2003; Khan, 2005;

Macdonald, 2006; McConnell, 2006; Quinn, 2005; Salmon, 2002; Schank, 2002; Thorne, 2003). Yet despite this wealth of publications these new works still do not focus on detailed quantitative analysis as to what works.

Other things being equal

Throughout the period the standard entry requirement for the undergraduate law degree remained on the old measure as 22 points at A-level. 22 points equates to BBC or 280 points using the current UCAS points system. Similarly the number, order and content of the lectures and seminars remained unchanged. The format of the assessed exercises and the proportion of marks for each element were unchanged. I remained module leader and sole course lecturer. The recommended textbook was unchanged. There were minor changes amongst the team of staff involved in running seminars, but each year the majority of seminar leaders remained unchanged.

The need to try to minimise the other changes led to the focus on the period 1999-2000 to 2003-2004. Prior to 1999 the course had been taught over 11 weeks rather than 10, with an additional one teaching week. The pre-1999 longer course format meant that there was one more two hour lecture, one more seminar and meant the coursework could be submitted one week later.[8] These changes were considered potentially important and therefore the 1999 cut off point was considered appropriate. 2003-2004 was considered the final year that could usefully be compared as in 2004-2005

[8] The later coursework hand in date had also allowed for a different order in which topics were taught.

there were major changes to the Brookes' modular degree. The results in 2004-05 are briefly explored in Appendix B. This analyses the increased take up of the online quizzes after the results of the earlier research were explained to students. However, because the module had changed as a result of university modular changes the results of this cohort are not included in the main analysis of the impact of the changes.

For the period 1999-2004 there were four possible groups to consider: (1) those students who were not offered the opportunity to take the quizzes, (2) those students who were offered the opportunity to take the quizzes, (3) from within the second group that subgroup who chose to take the quizzes and (4) those offered the chance to do the quizzes but who did not avail themselves of the opportunity. As there were nine quizzes that students could take then the third group could be subdivided in a variety of ways: for example, according to the number of quizzes taken or the number of marks achieved in answering quizzes.

The research had stemmed in part from the improved results in 2001-02 when online guidance had been provided. In that year, as previously discussed, it had not been possible to know which students had accessed the online materials and which had not. Therefore from the point of view of results analysis this year was rather problematic as I could not accurately categorise the students from that year as either ICT users or non-users. Accordingly for the purposes of my evaluation I have disregarded the results from that year and instead concentrate on comparing (1) those who had no

access to ICT materials (i.e. students in 1999-2000 and 2000-01), (2) those who had access to online quizzes and availed themselves of the opportunity and (3) those who had access to online quizzes but did not take any quizzes.

Table 5

Results after the introduction of online quizzes

Legal Method Results 2002-2003 and 2003-2004						
	2002-2003		2003-2004		*Aggregate results 2002-2004*	
Mark Grouping	Number of students	Percentage of cohort in each mark grouping	Number of students	Percentage of cohort in each mark grouping	*Number of students*	*Percentage of cohort in each mark grouping*
70% +	25	14.5%	33	16.4%	*58*	*15.5%*
60 - 69%	35	20.2%	51	25.4%	*86*	*23.0%*
50 - 59%	45	26.0%	49	24.4%	*94*	*25.1%*
40 - 49%	39	22.5%	43	21.4%	*82*	*21.9%*
Under 40%	29	16.8%	25	12.4%	*54*	*14.4%*
Size of cohort	173		201		*374*	

The results for the two years are broadly similar. In 2003-04 the results were very slightly better that those for the preceding year. There were two differences between 2002-03 and 2003-04. In 2002-03 the quizzes were made available in two batches. The first batch was made available after the week 4 lecture and the second batch after the final lecture. In 2003-04 the quizzes became available each week after the lecture. The timing in 2003-04 may have been slightly more helpful to students as it enabled them to test their understanding straight after the lecture. Additionally in 2003-04

registers were taken in seminars whereas they were not taken in other years. Whilst students were told that seminar attendance was optional, the taking of registers may have encouraged attendance. This possibly improved attendance[9] may have been a factor in the marginally better results in 2003-04. Although the taking of attendance registers in seminars might be expected to increase seminar attendance, none of the seminar leaders noted any marked change in seminar attendance as against other years. The link between seminar attendance and performance is explored later – see particularly Appendix A, Tables A3 & A8.

However, notwithstanding these differences the results over the two years were broadly similar and therefore it is proposed to focus primarily on the aggregate results for the two years.

Table 6

Comparing the Three Stages

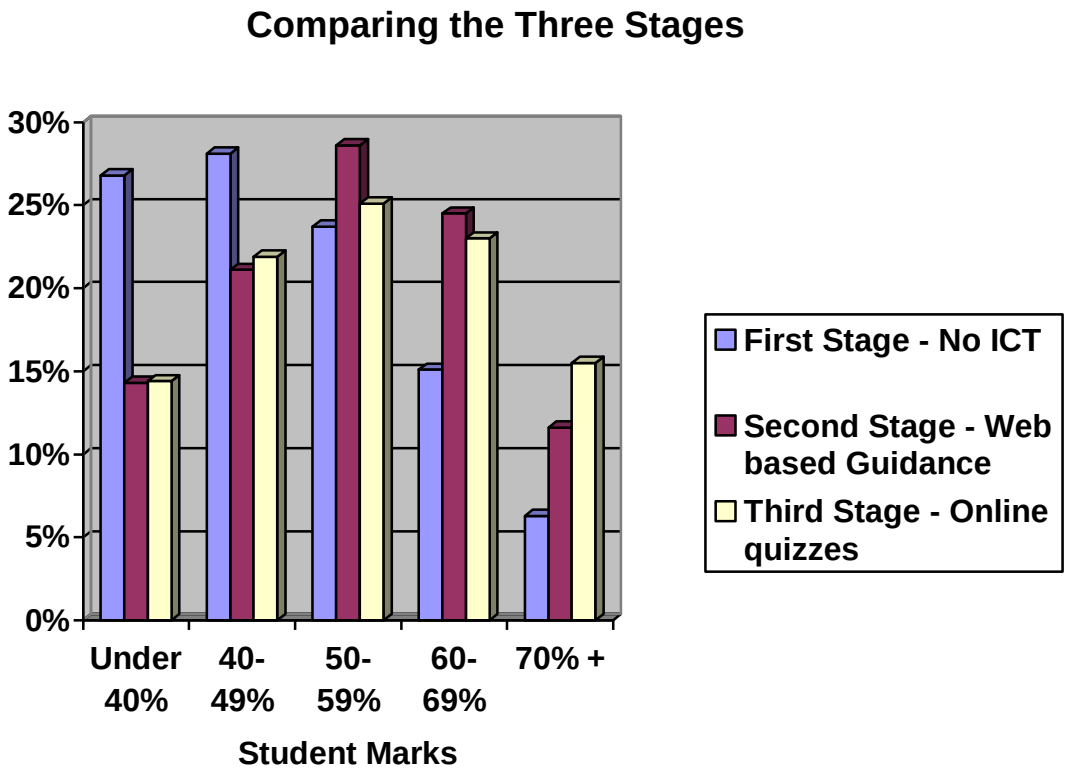
Legal Method Results						
	First Stage (pre web-based support) Aggregate results 1999-2001		Second Stage (web-based support, but before online quizzes) Results 2001-2002		Third Stage (web-based support and online quizzes) Aggregate results 2002-2004	
Mark Grouping	Number of students	Percentage of cohort in each mark grouping	Number of students	Percentage of cohort in each mark grouping	Number of students	Percentage of cohort in each mark grouping

[9] Although the taking of attendance registers in seminars might be expected to increase seminar attendance, none of the seminar leaders noted any marked change in seminar attendance as against other years.

70% +	14	6.3%	17	11.6%	58	15.5%
60 - 69%	34	15.1%	36	24.5%	86	23.0%
50 - 59%	53	23.7%	42	28.6%	94	25.1%
40 - 49%	63	28.1%	31	21.1%	82	21.9%
Under 40%	60	26.8%	21	14.3%	54	14.4%
Size of cohort	224		147		374	

Table 6 shows that the improved results following the introduction of online support were maintained. Prior to the introduction of online support over one quarter of students failed the module at first attempt. After the introduction of online support this figure dropped to less than 15%. If one categorises all results of below 50% as disappointing, then prior to online support almost 55% of results were disappointing, but after the introduction of online support this figure fell to just over 35%. In terms of the top results then the percentage of marks of 70% and over rose sharply from 6.3% in the period prior to the introduction of online support, to 11.6% when online guidance was offered and rose further to 15.5% when online quizzes were added. The results over the three periods are shown graphically in Chart 3 below.

Chart 3



The above chart and table demonstrate that the improvement noted in the 2001-02 cohort was maintained in the following two academic years. This supports the contention that the introduction of online support had improved performance. However, as discussed earlier, the question that emerges is whether this change was coincidental or whether it could be shown to be causally linked to the introduction of online support. The first intervention, when online guidance was offered, did not include any mechanism to test who had accessed the online guidance and who had not – as a result it had been impossible to test whether those who had accessed the information had outperformed those who had not. One of the main advantages of offering online quizzes through WebCT was that information as to who had taken the quizzes, how often they had taken the quizzes and how well they had performed on them was readily available. This therefore meant that the

thesis that those who accessed the quizzes would do better could be tested. It also meant that any differences between those who chose to take the quizzes and those who chose not to take the quizzes could be examined.

The number of quiz takers

If one simply splits the cohort into quiz takers (interpreted simply as those who took a minimum of one quiz) and non-quiz takers (those who did not attempt any of the quizzes) then over the two academic years 2002-03 and 2003-04 there were roughly equivalent numbers of quiz takers (183) and non-quiz takers (191). In percentage terms 48.1% were quiz takers and 51.9% were non-quiz takers. These results are remarkably close to the findings of Hester (1999) who found that 49% of students tried the interactive sample test he introduced as a supplement to a large lecture course on which he was teaching and broadly in line with Mackie's finding of a 59.6% take up rate (2006). Mackie divided users into those who attempted less than a quarter of the quizzes and those who attempted more than a quarter of all the quizzes. My findings see particularly Table 18 below suggest that most who attempted less than a quarter of quizzes in fact attempted none. It is not known whether Mackie's findings are similar in this respect.

Table 7

Comparing the Marks in Legal Method of Quiz Takers and Non-Quiz Takers

	Quiz Takers Aggregate results 2002-2004		Non-Quiz Takers Aggregate results 2002-2004	
Mark Grouping	Number of students	Percentage of cohort in each mark grouping	Number of students	Percentage of cohort in each mark grouping
70% +	45	24.6%	13	6.8%
60 - 69%	53	29.0%	33	17.3%
50 - 59%	52	28.4%	42	21.9%
40 - 49%	25	13.7%	57	30.1%
Under 40%	8	4.4%	46	24.1%
Size of cohort	183		191	

Chart 4

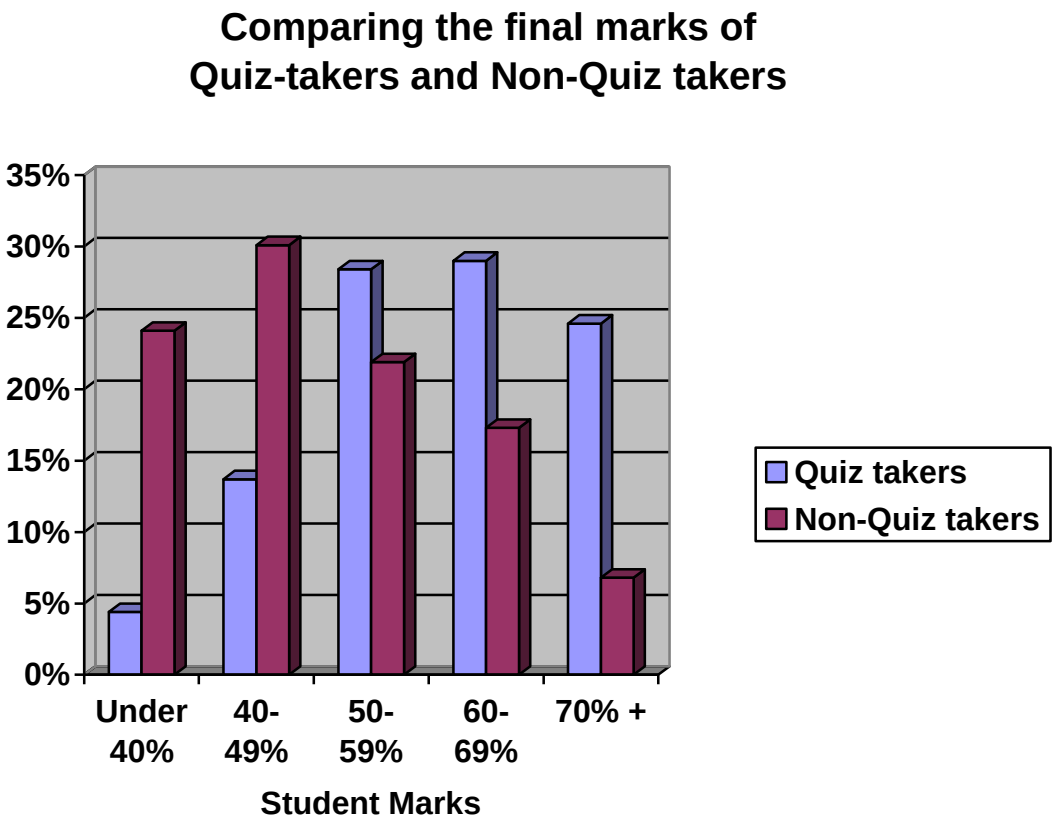


Table 7 and Chart 4 above show a dramatic difference between the results of quiz takers and non-quiz takers. Almost one quarter of the quiz takers (24.6%) obtained marks of 70% and above as against only 6.8% of the non-quiz takers. Over half (53.6%) of the quiz takers got marks of over 60% compared to less than one quarter of the non-quiz takers (24.1%). In terms of fails: less than one quiz taker in twenty failed (4.4%), as against almost one non-quiz taker in four (24.1%).

The results might suggest that quiz takers' results were enhanced because they took the quizzes, but before this conclusion can be drawn it is necessary to compare those who took the quizzes as against those who did not. Students were free to do the MCQs or not, therefore whether they

ended up classed as quiz takers or not was a matter of self selection. It is therefore important to understand how the composition of the two groups compared – were the quiz takers simply the harder working students who were always more likely to succeed? Whilst initially plausible, on further reflection, this was unlikely to be the whole answer.

Apart from the introduction of online guidance and quizzes the course was run unchanged from the module that had run in 1999-2000 and 2000-2001. The lectures, seminars, methods of assessment, course entry requirements and duration and timing of the course had all remained unchanged. It might be plausible to think that the harder working, more conscientious students, who were always more likely to succeed, would be the ones most likely to take the quizzes. However, this would not explain any improvement in overall marks when comparing the results before the provision of any e-learning support with those after the introduction of such support. Logically, one would anticipate that the proportion of hard working, conscientious students would remain broadly constant. Therefore, other things being equal, the marks would remain broadly comparable. However, as shown in Table 6 and Chart 3 above, the final marks of students in the module demonstrated a marked improvement after the introduction of e-learning support.

In looking at the impact of the quizzes and online support it is interesting to compare the results of the non-quiz takers with the results of the entire

cohort prior to the introduction of any e-learning support. This is shown in Table 8 and Chart 5 below:

Table 8

Comparing non-quiz takers with the situation prior to intervention

	First Stage (pre web-based support) Aggregate results 1999-2001		Non-Quiz Takers Aggregate results 2002-2004	
Mark Grouping	Number of students	Percentage of cohort in each mark grouping	Number of students	Percentage of cohort in each mark grouping
70% +	14	6.3%	13	6.8%
60 - 69%	34	15.1%	33	17.3%
50 - 59%	53	23.7%	42	21.9%
40 - 49%	63	28.1%	57	30.1%
Under 40%	60	26.8%	46	24.1%
Size of cohort	224		191	

Chart 5

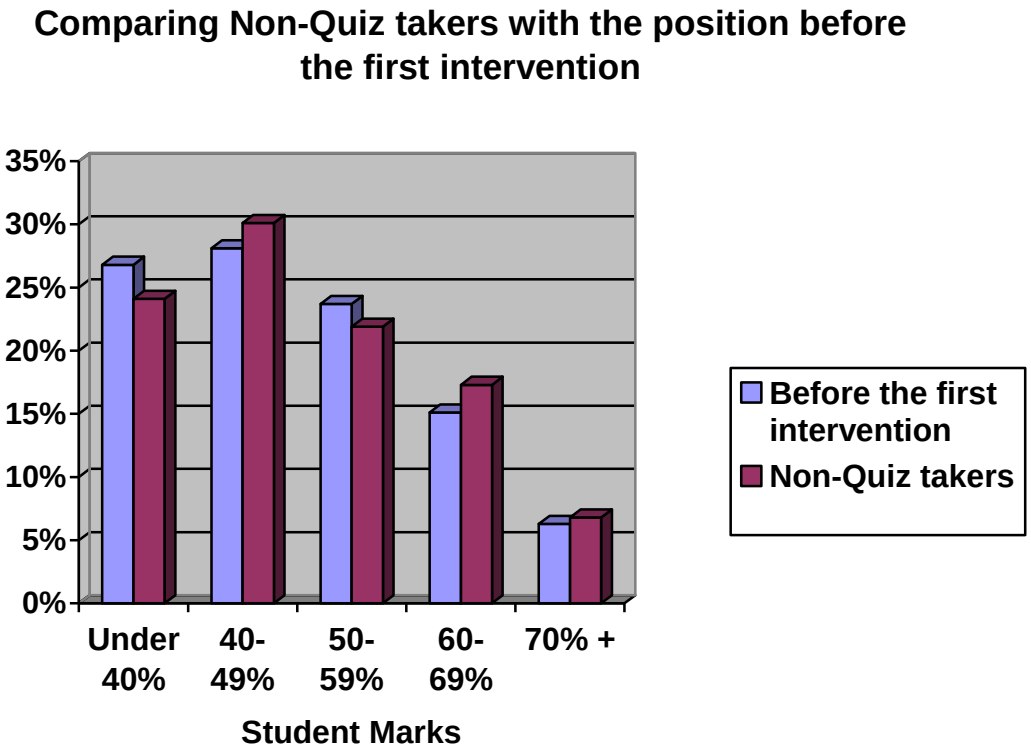


Table 8 and Chart 5 show a very marked similarity between the results of students before the introduction of e-learning support with the results of those who chose not to take the quizzes that were on offer. In both groups around 25% failed the module at first attempt (26.8% cf. 24.1%). Similarly around 55% obtained marks of under 50% (54.9% cf. 54.2%). At the top end, less than 7% obtained marks of over 70% (6.3% cf. 6.8%) and less than 25% got marks of 60% and over (21.4% cf. 24.1%). The similarity of the two groups would support the contention that as the course assessment, course delivery and type of student was largely unchanged so the results should be broadly in line. The non-quiz takers, by not taking advantage of the quizzes on offer (and presumably not taking advantage of the online guidance either) were essentially following the same course as the entire cohort had been following before the introduction of e-learning and their

results were very similar. This analysis suggests that the non-quiz takers were fairly typical of the entire cohort. The truth of this preliminary conclusion was then tested.

What sort of student took the quizzes?

The foregoing analysis, based on the similarity of the results of non-quiz takers with the results of the entire pre-e-learning cohort, led to the development of a hypothesis that the non-quiz takers were fairly typical of the entire cohort and therefore broadly similar to the quiz takers except that by definition they did not avail themselves of the opportunity to take the quizzes. This thesis ran counter to the initial thesis that the quiz takers were most likely to be the hardest working, most conscientious students. If the original hypothesis had been true the expectation was that the non-quiz takers' results would be worse than the results of the entire pre-e-learning cohort. However, as shown in Table 8 and Chart 5 above the results of the non-quiz takers were no worse than and indeed were remarkably similar to those of the pre-e-learning cohort.

Factors affecting quiz taking

Having divided the cohort into two broadly similar sized halves, those who took one or more quiz and those who attempted none of the quizzes it was then possible to interrogate the data to see whether certain types of student were more likely to attempt the quizzes. In doing this I decided to concentrate on the 2003-04 cohort. There were a number of reasons for this decision. It reduced the amount of data to be handled to a more

manageable amount – 201 student records as against 374. It also enabled me to consider a potentially significant variable namely seminar attendance – information about which was only available for 2002-03.

The entry qualifications of quiz takers and non-quiz takers

The main route by which students were assessed for entry onto the law degree was by means of A-level grades. Of the 201 students in the 2003-04 cohort, 157 (78%) were accepted mainly or wholly on the basis of their A-level results. If the revised hypothesis was correct then it was likely that the A-level grades of quiz takers were going to be broadly similar to the A-level grades of non-quiz takers. If the original hypothesis was correct then, on the assumption, that harder working, more conscientious students were more likely to do better at A-level then the expectation would have been that, assuming they carried on being harder working and more conscientious when they arrived at university, the quiz takers would have better A-level grades than the non-quiz takers.

Table 9

Average A-level points of quiz takers and non-quiz takers

	Number	Average A-level points
Quiz takers with A-levels	81	22.12
Non-quiz takers with A-levels	76	22.63
All students with A-levels	*157*	*22.37*

Table 9 shows that the average A-level points of the quiz takers and non-quiz takers were virtually identical; with the average A-level grades of the non-quiz takers actually being fractionally higher. This would seem to support the revised hypothesis that there was very little difference between the quiz takers and non-quiz takers and run counter to the original hypothesis that the "better" students (in this case measured in terms of A-level entry) would be more likely to take the quizzes.

Throughout the period in question entry onto the Brookes' law degree for A-level students was primarily based on students' A-level results, but in common with many other universities during the period Brookes was also taking account of students' AS-level results.

Table 10

Average UCAS points of quiz takers and non-quiz takers

	Number	Average UCAS points
Quiz takers with A-levels	81	335.55
Non-quiz takers with A-levels	76	323.68
All students with A-levels	*157*	*329.81*

Like Table 9, this calculation of average entry qualifications shows very little difference between the quiz takers and the non-quiz takers. The quiz takers averaged just under 6 points more than the average UCAS points of that part of the cohort admitted on the basis of their A-levels, whereas the non-quiz takers averaged a fraction over 6 points under the average. However, since 6 points is less than 2% of the average point score

of 329.81 the main point to note is the similarity of the average entry qualifications of the two groups. The extent to which the results of the two groups was similar is evidenced by the fact that it was so close that the method of counting affected which came out higher - on the basis of A-level results alone the non-quiz takers were marginally better qualified on average, whereas adding in the 'AS' results it was the quiz takers who emerged as on average the slightly better qualified.

Gender

The 2003-04 cohort showed little difference in terms of quiz taking and gender. Female students were more likely to be quiz takers, this is in line with the findings of Mackie (2006). Mackie found that 64% of female students attempted over a quarter of the tests in her first year Business Studies module as against 56% of male students. This runs counter to the expectations that could be developed from Chmielewski (1998) that men generally have more knowledge of the web. Research on student use of web learning differentiated by gender is limited and inconclusive. Arbaugh (2000) and Jackson et. al. (2001) both found that male students were less likely to enter into dialogue via the web. However, Hoskins & van Hooff (2005) found the opposite. This last piece of research also looked at quiz taking and found that male students were more likely to repeat an online quiz than female students.

Table 11

Quiz takers by gender

	Total	**Quiz Takers**		**Non-Quiz Takers**	
		Number	Percentage	Number	Percentage
Female	118	67	56.8%	51	43.2%
Male	83	42	50.6%	41	49.4%

Male students taking Legal Method at Oxford Brookes divided equally between quiz takers and non-quiz takers. Female students were slightly more likely to take the quizzes, but for both groups the take up could be described as being between 5 or 6 out of 10 taking the quizzes.

Age

The average age is calculated on the basis of the students' age in years at the beginning of the academic year.

Table 12

Average age of quiz takers and non-quiz takers

	Number	Average Age
Quiz takers	109	20.71
Non-quiz takers	92	19.50
All students	201	20.15

Table 12 suggests that there was little difference between the average age of quiz takers (20.71 years old) and the average age of non-quiz takers (19.5 years old). However, this does not give the full picture. 103

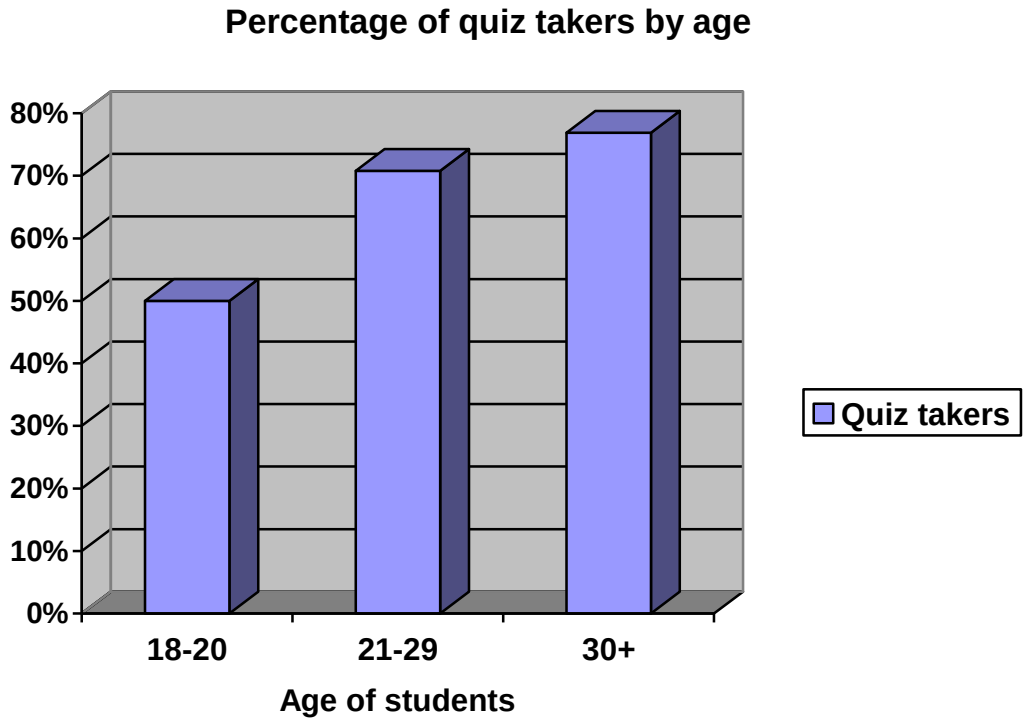
(51.2%) of the 201 students in the cohort were 18 at the start of the course. A further 45 students were aged 19 (22.4%) - therefore almost three quarters of the cohort (73.6%) were 18 or 19. Given the numbers involved any assessment of the average age is going to be dominated by this group who make up the bulk of the cohort. What this analysis misses is whether mature students were more or less likely to take the quizzes. Table 13 below addresses this question.

Table 13

Quiz Taking by Age Grouping

Age	**Number in cohort**	**Quiz Takers**		**Non-Quiz Takers**	
		Number	Percentage of age group	Number	Percentage of age group
18	103	52	50.5%	51	49.5%
19	45	23	51.1%	22	48.9%
20	16	7	43.8%	9	56.3%
18 - 20	*164*	*82*	*50.0%*	*82*	*50.0%*
21 - 29	24	17	70.8%	7	29.2%
30 +	13	10	76.9%	3	23.1%

Chart 6



Young students (i.e. those aged 18 - 20) were equally divided between those who took the quizzes and those who did not. However, older students were considerably more likely to take the quizzes - over 70% of students aged between 21 and 29 took the quizzes and nearly 77% of those aged 30 and above took the quizzes. Owing to the small number of students aged over 30 it is perhaps more appropriate to group all 37 students aged 21+ together: of this group 73% took at least one quiz.

These findings would seem to run counter to the idea that the major change is amongst the younger generation (Lindsay & Breen, 2000; Veen 2003, 2005) whose learning styles have been transformed by embracing computer technology. However, it is in line with the findings of Mackie (2006) and Hoskins & van Hooff (2005).

Summarising the finding on who took the quizzes

A-level entry qualifications do not appear to have been a determinant. Female students were slightly more likely to take quizzes than male students, but not to a major extent. The biggest disparity identified so far was in relation to age, with older students markedly more likely to take the quizzes. This finding raises the possibility that it is perhaps the non-traditional student who is most likely to make use of the quizzes.

Less traditional students

Just as most students tend to commence their undergraduate studies between the ages of 18 - 20 (81.6% of the 2003-04 cohort), the main entry qualification of most students when they enter higher education tends to be A-level grades (78.1% of the 2003-04 cohort). Table 14 and Chart 9 below examine whether those entering by means other than A-levels were more or less likely to attempt the quizzes.

Table 14

Likelihood of quiz taking on the basis of previous educational background

		Quiz Takers		Non-Quiz Takers	
	Number	Number	Percentage	Number	Percentage
Entry based on A-level grades	157	81	51.6%	76	48.4%

Entry not based on A-level grades	44	28	63.6%	16	36.4%
All students	*201*	*109*	*54.2%*	*92*	*45.8%*

Chart 7

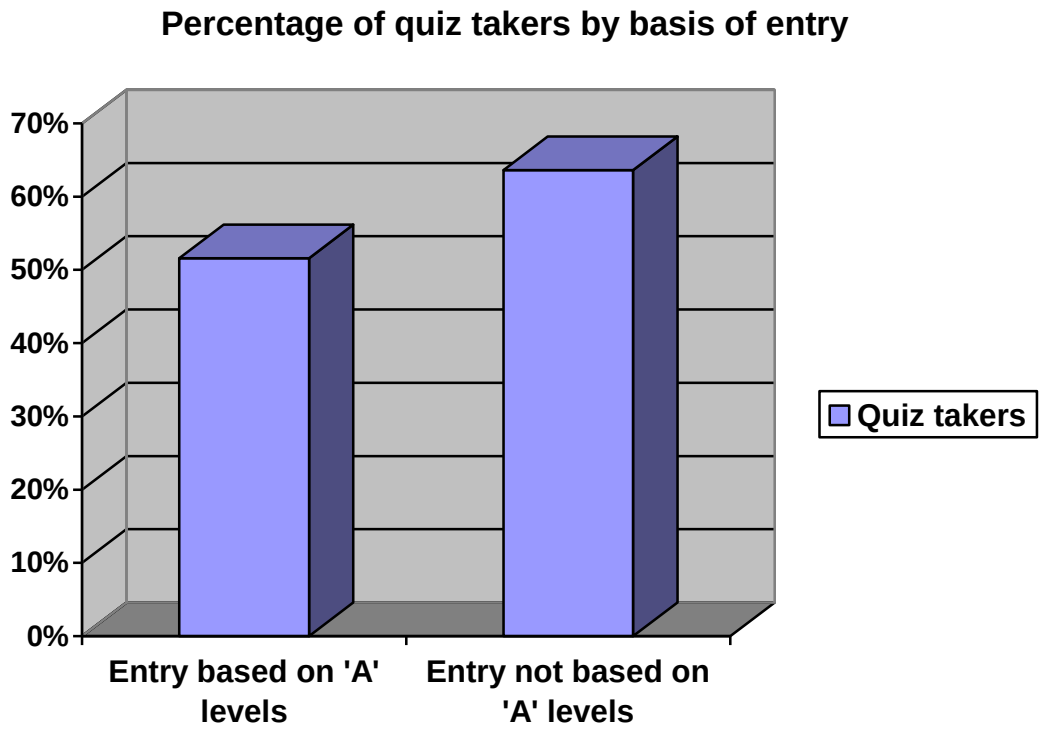


Table 14 and Chart 7 show that whilst those entering university having previously taken A-levels were split roughly evenly between quiz takers and non-quiz takers, the percentage of those whose entry was not based on A-levels who were quiz takers was 12% higher. In part this disparity and the age disparity reflect the attitudes of the same students as 28 students fell within both categories (i.e. they were students aged 21 and over whose entry was not based on A-level grades).

Nationality

Just as most of the students were aged 18 - 20 (81.6%) and had gained entry on the basis of their A-levels (78.1%), so similarly most of the students were UK nationals (77.6%). Table 15 and Chart 8 below show the percentage of quiz takers according to nationality. No more than four of the 2003-04 cohort were of the same non-UK nationality and therefore the main comparison has been made simply between UK nationals and non-UK nationals. However, the figures for non-UK EU nationals are interestingly slightly at variants with those of non-EU nationals and therefore in Table 15 the non-UK category is subdivided into these two categories. However, before any strong conclusions are made the small sample size (especially of the non-UK EU national category) should be noted. Nevertheless the greater uptake of quizzes by non-European students is supported by Mackie (2006). Mackie found that 68% of non-European students engaged with the quiz as against 59% of UK and 59% of non-UK European students.

Table 15

Quiz Taking by National Grouping

Nationality	**Number in cohort**	**Quiz Takers**		**Non-Quiz Takers**	
		Number	Percentage	Number	Percentage
UK	156	78	50.0%	78	50.0%
Other European Union	12	7	58.3%	5	41.7%
International (non-EU)	33	24	72.7%	9	27.3%
All non-UK	*45*	*31*	*68.9%*	*14*	*31.1%*

national students					
All students	*201*	*109*	*54.2%*	*92*	*45.8%*

Chart 8

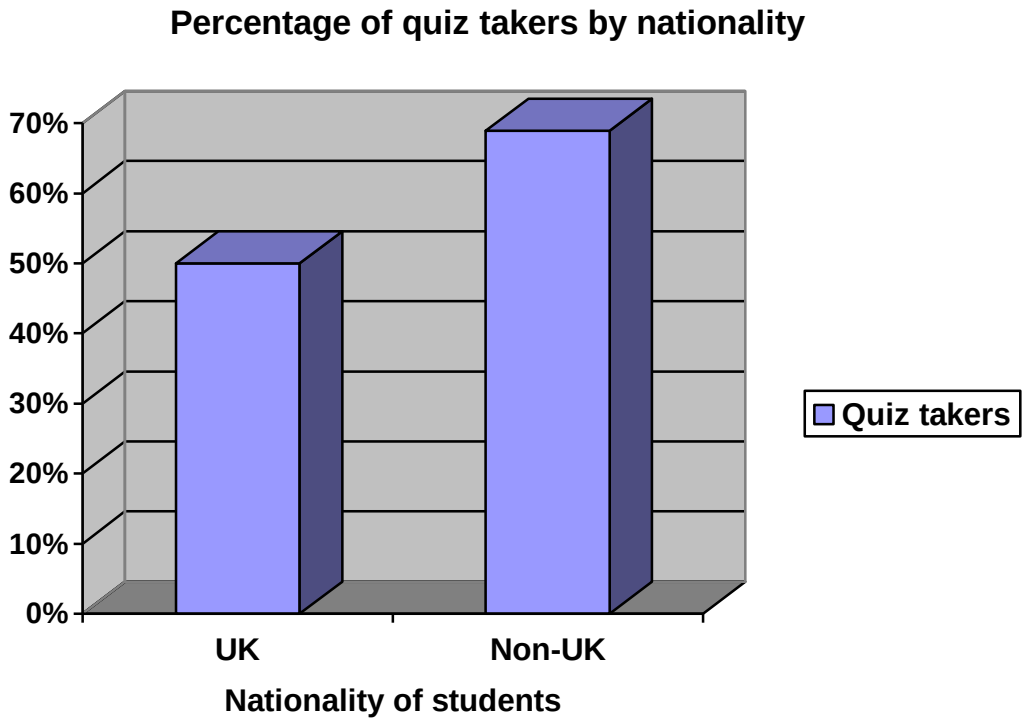


Table 15 and Chart 8 above show that non-UK nationals were significantly more likely to have taken quizzes than their UK counterparts. Whereas only half the UK nationals attempted one or more of the quizzes, the figure for non-UK nationals was almost 69% and the figure for non-EU nationals was nearly 73%.

Prior study of law

The cohort was divided into three parts: those students who had studied law at either A or AS-level, those students whose entry qualifications did not

give a clear indication as to whether they had or had not studied law and those who appeared never to have studied law prior to university.

Table 16

Prior study of Law and quiz taking

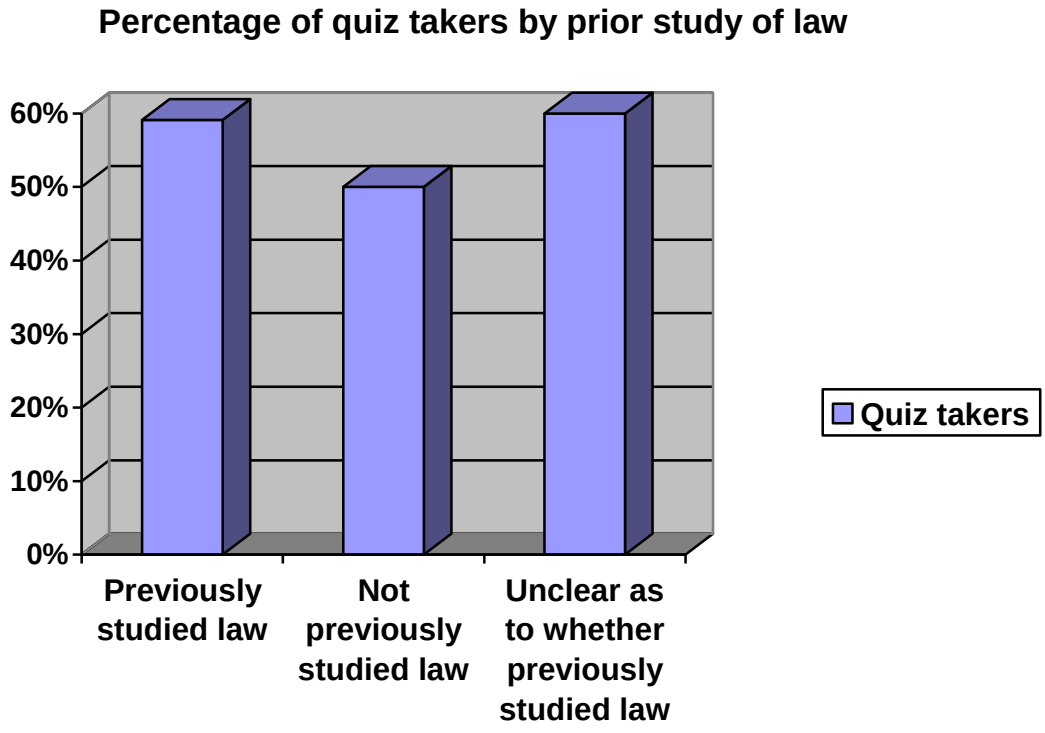
		Quiz Takers		Non-quiz takers	
	Number	Number	Percentage	Number	Percentage
Previously studied law at A-level or AS-level[10]	44	26	59.1%	18	40.9%
No evidence of prior study of law[11]	114	57	50.0%	57	50.0%
Prior study of law unclear[12]	43	26	60.0%	17	40.0%
All students	*201*	*109*	*54.2%*	*92*	*45.2%*

Chart 9

[10] Most years at the start of the module I asked for a show of hands to indicate what proportion of students had studied law prior to university. Typically about a quarter of the students raised a hand. This would seem to indicate that the 44/201 (21.9%) constituted the bulk of those who had previously studied law.

[11] These students had gained admission on the basis of subjects that clearly did not include law. Whilst, it was possible that at other points in their studies (for example at GCSE) they might have studied law there was no indication of this in their student record and it seemed unlikely that many (or possibly any) of these students would have studied law, then given it up, only to take it up again at degree level.

[12] These students had entry qualifications which might or might not have included law; for example an Access course or a BTEC national course qualification. Unfortunately the data I could access did not identify the subjects actually studied on such courses.



Again there was little difference between the three groups. Those who had not previously studied law were less likely to attempt the tests than those who had, but the difference in take-up rate was only 9.1%. The group that was marginally most likely to take the quizzes were those where it was unclear whether they had previously studied law. This group included 10 of the 13 students aged over 30, already identified to be considerably more likely to take the quizzes than their younger counterparts (see Table 11 and Chart 7 above). If one excludes these 10 students from those about whom it was unclear whether they had previously studied law the percentage of quiz takers drops to 48.3%. Therefore if one discounted the fact that older students were more likely to be quiz takers one could conclude that prior study of law also tended to slightly increase the likelihood of quiz taking. Assuming that those who had previously studied law were likely to be more

confident in their legal skills when tackling a first term, first year law module this might suggest that willingness to engage with quizzes was in part a question of confidence - with those more confident in their abilities more prepared to attempt the quizzes. However, before developing this line of thought much further it should be noted that the difference in the percentage taking quizzes between those who had and those who had not previously studied law was quite small and that this conclusion was not borne out if one assumed that those with better A-level results were more likely to be more confident in their abilities.

Quiz taking and seminar attendance

As stated earlier, in 2003-04 seminar attendance was monitored. This monitoring did not arise directly out of this research project. It arose because student representatives on the course management committee wanted to investigate whether attendance at seminars affected student performance. This enabled an assessment to be made as to whether those who attended seminars more regularly were more likely to be quiz takers. As seen in Table 17 below, those who took at least one quiz generally attended more seminars. The data, whilst showing a link between quiz taking and seminar attendance, does not prove a causal relationship. It is impossible to state whether seminar attendance led to quiz taking or whether quiz taking led to increased seminar attendance. However, it is possible to note that those who took at least one quiz were generally more engaged with the course (if one measures engagement by seminar attendance).

Table 17

Quiz taking and seminar attendance

	Number	**Average number of seminars attended**	**Percentage of the 8 seminars attended**
Quiz takers	109	6.1	76.3%
Non-quiz takers	92	4.5	56.3%
All students	*201*	*5.4*	*67.5%*

Subdividing the quiz takers

Thus far, the analysis has been of the basis of categorising students into two sub-categories: quiz takers and non-quiz takers. This has the advantage of focussing on two large, approximately equal sized groupings. However, by lumping together students who attempted one quiz with those who attempted all the quizzes the analysis is not as nuanced as it might be.

Table 18

Number of quizzes attempted

Number of quizzes attempted	Number of students	Percentage of cohort
None	92	45.8%
One	7	3.5%
Two	12	6.0%
Three	7	3.5%
Four	4	2.0%
Five	5	2.5%
Six	9	4.5%
Seven	4	2.0%
Eight	6	3.0%
Nine	55	27.4%

In 2003-04 the majority of students (54.2%) attempted at least one quiz. However, as can be seen from Table 18 above, whilst half of quiz takers took all the quizzes (55 of the 109 quiz takers = 50.5%), the remainder were spread fairly evenly between the other options. This meant that there was a very small sample size for any of the other totals of quizzes attempted.

Table 19

Number of quizzes attempted by sub-grouping

Number of quizzes attempted	Number of students	Percentage of cohort
None	92	45.8%
At least one but less than half	30	14.9%
More than half but less than all	24	11.9%
All nine quizzes	55	27.4%

On the basis of the earlier conclusions it might be expected that those who attempted more quizzes would have performed better in the Legal Method module. This is in part borne out in Table 20 below. As expected those who attempted no quizzes did perform less well than any of the sub-categories of quiz taking. Similarly those who attempted less than half the quizzes did less well than those who attempted over half the quizzes. The one surprising finding was that those who did all nine quizzes actually performed slightly less well than those who attempted between five and eight of the nine quizzes.

Table 20

Performance in quizzes by sub-grouping

Number of quizzes attempted	Number of students	Mean percentage in Legal Method
None	92	49.8%
At least one but less than half	30	55.5%
More than half but less than all	24	61.4%
All nine quizzes	55	59.5%

It is worth noting that the group who took between five and eight quizzes were numerically quite small (only 24 students). It is also worth noting that within this grouping taking more quizzes was generally linked with higher performance. Perhaps one explanation of the discrepancy is that the sub-grouping of students who attempted all nine quizzes included a certain number of students who felt that they were struggling on the course and were driven to attempt all the quizzes because of fear of failure – however, this is just conjecture.

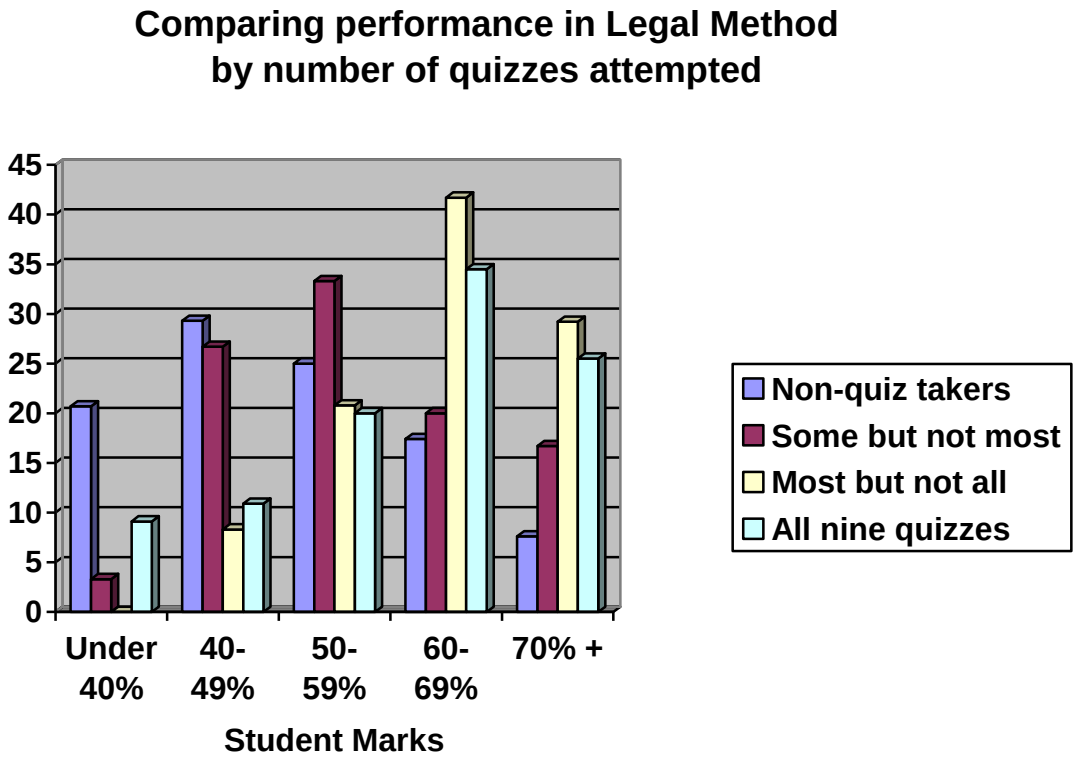
Table 21 and Chart 10 below arguably lend some support to this hypothesis. However, having started with relatively small sample sizes for the two groupings based on students taking some, but not all of the quizzes, by further sub categorising these groups there is a danger in drawing definite conclusions.

Table 21

Comparing performance in Legal Method by number of quizzes attempted

	Non-quiz takers		Quiz takers					
			Attempted less than half of the quizzes		Attempted more than half but less than nine		Attempted all nine quizzes	
Mark Grouping	Number of students	% of cohort in each mark grouping	Number of students	% of cohort in each mark grouping	Number of students	% of cohort in each mark grouping	Number of students	% of cohort in each mark grouping
70% +	7	7.6%	5	16.7%	7	29.2%	14	25.5%
60 - 69%	16	17.4%	6	20.0%	10	41.7%	19	34.5%
50 - 59%	23	25.0%	10	33.3%	5	20.8%	11	20.0%
40 - 49%	27	29.3%	8	26.7%	2	8.3%	6	10.9%
Under 40%	19	20.7%	1	3.3%	0	0.0%	5	9.1%
Size of cohort	92		30		24		55	

Chart 10



The above Chart and Table clearly demonstrate that students who did between five and nine of the quizzes were considerably more likely to gain marks of 60% and above. Conversely those who did less than five of the quizzes were much more likely to achieve marks of less than 50%.

Assessing the impact of quiz taking on performance statistically

The foregoing examination of results, particularly Tables 4, 5, 6, 18 and 19 together with Charts 3, 4, 5 and 10, have suggested that quiz taking may improve student performance.

Table 22

Correlation - Quiz Attempts and Legal Method Marks

		Quizzes attempted	Marks for Legal Method
Quizzes attempted	Pearson Correlation	1	.348(**)
	Sig. (1-tailed)		.000
	N	201	201

The significance level indicates that there is a less than 0.01 probability that a correlation coefficient this large in a sample of 201 people would have occurred by chance. This does not however, automatically mean that quiz taking is leading to better exam performance. There could be a third variable affecting both quiz taking and exam performance. Additionally the existence of the link between exam performance and quiz taking does not prove the direction of any causal link. However, the finding is in line with the thesis that quiz taking improves performance. Furthermore, as quiz taking precedes exam performance logically it seems logical that if there is any link it must be that quiz taking that affects performance. On the basis of the research model adopted it would seem that there is no third variable. When quizzes were introduced in 2002-03 every effort was made to ensure that other variables remained unchanged. The performance of the entire cohort in 2002-04 was markedly better than that achieved prior to the introduction of online support (see Table 4 and Chart 3 above) and the performance of non-quiz takers was remarkably similar to that of the entire cohort prior to the introduction of online support (see Table 6 and Chart 5 above).

Thus far it has been shown that quiz taking appears linked to improved performance in the module. The measurement of the Pearson correlation coefficient suggests that there is a more than 99% chance that quiz taking and student performance are linked. Furthermore the square of the Pearson correlation coefficient (r^2) should indicate the effect of the quizzes on student performance: $r^2 = .1211$ indicating that 12% of student marks in Legal Method can be attributed to quiz taking. This is examined in more detail in Appendix A which explores the impact of quiz taking and other variables on performance in Legal Method.

The research examined so far has also shown that those most likely to avail themselves of the opportunity to take quizzes were non-traditional students: in particular mature students, non-UK students and students with entry qualifications other than “A” levels. The next stage was to consider whether the impact of the quizzes extended beyond the Legal Method module in which they were set.

Measuring the Impact beyond the Module

During first year

Full-time law students at Oxford Brookes at the time could take up to five other law modules in their first year. None of these modules included online quizzes or any other form of interactive online support. Given that the quizzes were designed simply to support the Legal Method module it might be assumed that there would be no difference in the performance of the Legal Method quiz takers and non-quiz takers in these other modules. However, Table 23 below shows that in all modules the Legal Method quiz takers outperformed the non-quiz takers.

Table 23

Performance of Quiz Takers and Non-Quiz Takers in other first year law modules (2003-04 cohort)

	Quiz Takers		**Non-Quiz Takers**		**Percentage by which Legal Method quiz takers outperformed non-quiz takers**	**Pearson correlation coefficient (1-tailed)**
	Number of students	Average Mark	Number of students	Average Mark		
Legal Method Term 1 15 credits	109	58.8%	92	49.8%	+ 9.0%	.348**
Legal Process Term 1 15 credits	71	56.8%	43	50.0%	+ 6.8%	.362**
Contract Terms 1 & 2 30 credits	96	46.8%	77	36.0%	+ 10.8%	.392**
Constitutional Law Term 2 15 credits	86	47.7%	54	43.9%	+ 3.8%	.230**

Tort Term 2 & 3 30 credits	105	44.6%	83	36.9%	+ 7.7%	.335**
Law and Morality Term 3 15 credits	75	60.4%	52	55.4%	+ 5.0%	.124

** Indicates correlation is significant at the .001 level. In other words in relation to all modules (except Law and Morality) there is a less than a one in 1,000 chance that the apparent link between the number of quizzes taken and performance in the module in question was simply down to chance. In the case of Law and Morality, whilst there did appear to be some positive link between quiz taking in Legal Method and performance in Law and Morality, the possibility that this was simply down to chance was greater than 5%.

The one module that showed a much lower correlation between student performance and the number of quizzes attempted in Legal Method was Law and Morality. This module was assessed in a different way to the other modules, being the only first year law module assessed entirely by coursework. Furthermore the assessment involved group tasks and oral presentations unlike the other first year module, which were all assessed on the basis of individual written work. Finally the style of teaching in Law and Morality was different with workshops being used rather than lectures and seminars. Perhaps these many differences explain the fact that Legal Method quiz taking did not seem to have such an impact on performance, though it should still be noted that Legal Method quiz takers still outperformed non-quiz takers by 5% in Law and Morality.

It is interesting to note that amongst the other modules the biggest disparity between the performance of quiz takers and non-quiz takers was found in the two 30 credit two term modules. Indeed the disparity in Contract Law was even greater than the disparity in Legal Method, with quiz takers out performing non-quiz takers by 10.8%. This is at first sight surprising. The quizzes were specifically designed to support the Legal Method module and therefore one might have anticipated the biggest impact would be in that module.

A possible explanation lies within the structure of Contract and Tort. Both are two term modules and amongst staff there has been a concern that students, in their first term of these two term modules, tend to focus on their studies less than they do when studying a one term module. This impression is supported by the fact that marks in the two term modules have tended to be lower. Arguably, if the problem with the two term modules does relate to disengagement then possibly the quizzes are, at least for the quiz takers, helping to maintain engagement across the whole programme. Certainly quiz taking was linked within Legal Method with better seminar attendance and so perhaps this better seminar attendance was replicated across the first year programme. Seminar attendance records were not kept in any of the other modules – therefore this theory could not be tested.

Over the Degree

The earlier article included no longer term analysis of the performance of students beyond first year.

Whilst a strong statistical link had been discerned between quiz taking and module performance in first year, this did not indicate whether this link would continue into the rest of the students' studies. Under the modular course rules at Oxford Brookes the results of Level 1 modules such as Legal Method and the other first year modules considered in Table 21 above do not contribute to degree classification or final graduating average. Full-time students studying Legal Method in 2003-04 should normally expect to graduate in June 2006. Given that virtually all Brookes' undergraduate law students are full-time and given the problems, at the time, of differentiating between full and part-time students under the Brookes' modular scheme, the following analysis treats the whole cohort as if full-time.

Table 24

Graduating averages of Legal Method quiz takers and non-quiz takers (2003-04 cohort)

	Quiz Takers		**Non-Quiz Takers**		**Percentage by which Legal Method quiz takers outperformed non-quiz takers**	**Pearson correlation coefficient (1-tailed)**
	Number of students	Average Mark	Number of students	Average Mark		
Graduating Average	69	58.5%	41	57.6%	+ 0.9%	.162*

* Correlation is significant at the 0.05 level (one-tailed). In other words there was a less than 5% likelihood that this link arose purely by chance.

Whilst Table 24 does show a significant positive correlation between the number of quizzes taken and final graduating average, the Table also shows little difference in the graduating average of quiz takers and non-quiz takers. At first sight, this would tend toward a conclusion that the impact of the online quizzes was largely short-lived and that whilst it did survive through to graduation it had to an extent dissipated by the time students completed their degree. However, if one examines the data further a more complex picture emerges.

Table 25

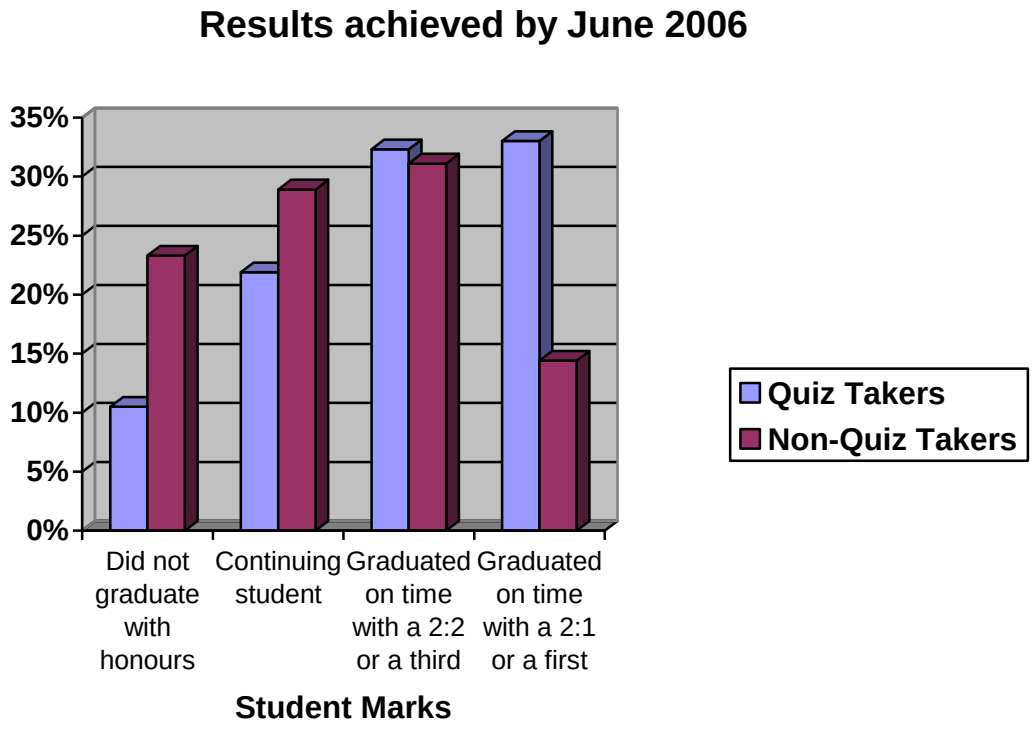
Results after three years (students taking Legal Method in 2002-03)

	Quiz Takers		**Non-Quiz Takers**	
	Number of students	Percentage of quiz takers	Number of students	Percentage of non-quiz takers
Graduated on time with first class honours	0	0.0%	0	0.0%
Graduated on time with upper second class honours	35	33.3%	13	14.4%
Graduated on time with lower second class honours	32	30.5%	26	28.9%
Graduated on time with third class honours	2	1.9%	2	2.2%
Graduated with honours on time	*69*	*65.7%*	*41*	*45.6%*
Not yet completed but still studying	23	21.9%	26	28.9%
Graduated with an ordinary degree	2	1.9%	1	1.1%
Graduated with a Certificate in Higher Education	2	1.9%	3	3.3%
Withdrawn voluntarily	8	7.6%	13	14.4%
Academic failure	1	0.9%	6	6.7%
Completed studies	*11*	*10.5%*	*21*	*23.3%*

without graduating with honours				

Almost two-thirds of quiz takers graduated with honours on time as against less than half of non-quiz takers. A third of quiz takers graduated on time with a 2:1 as against one in seven of the non-quiz takers. By June 2006 approaching one quarter of non-quiz takers had completed their studies without graduating with honours, whereas the comparable figure for quiz takers was closer to one in ten. These findings are shown graphically in Chart 11.

Chart 11



From the foregoing, two possible explanations for the better performance of the quiz takers emerge. One is that the quizzes encourage students to

engage not just with the module but with the degree programme as a whole and that this engagement continued throughout their studies. A second explanation relates to the view that Legal Method is a building block for future legal studies and that the quizzes helped quiz-taking students to develop these essential skills which then helped them in their future studies. These explanations are not mutually exclusionary. The quizzes could both have fostered engagement and helped in the development of skills. Alternatively, as highlighted earlier, there may be a third, as yet undiscovered, explanation. However, given the attempts to keep all other variables unchanged and the similarity between the performance of non-quiz takers with the performance of the entire cohort before the introduction of online support it would seem that the evidence does point to quiz taking having a significant impact not just in the module in which the quizzes were situated but throughout the degree programme.

Conclusions

The introduction of online quizzes resulted in markedly better performance in the module in question. The percentage of fails dropped from 26.8% before the introduction of online support to 14.4% and the percentage of marks under 50% similarly fell from 54.9% to 36.3%. The percentage of marks of 60% and above went up from 21.4% to 38.5% and of these the percentage that were marks of 70% and above went up from 6.3% to 15.5% (see Table 4 and Chart 3 above). This was achieved despite the fact that only 48.9% of students in the period 2002-04 attempted any of the quizzes. If one looks at the performance of quiz takers alone then the

results are particularly impressive. The fail rate for quiz takers was only 4.4% and only 18.1% got marks of below 50%. The improvement was seen not just in terms of a reduction in poor results: 53.6% of quiz takers gaining marks of 60%+, with 24.6% of quiz takers achieving marks of 70%+ (see Table 5 and Chart 4 above).

In 2003-04 the quizzes were released, as planned, immediately after the lectures. In this year the quiz take-up rate rose to 54.2%, with half of quiz takers attempting all nine quizzes (see Table 16 above). Analysis of this cohort showed that non-traditional students (non-UK, mature, non-A-level entry students) were most likely to make use of the quizzes (see Tables 13, 14 and 15 above). These are groups who are often viewed as more likely to struggle on courses designed for the traditional entrant. The fact that these students embraced the quizzes is particularly welcome. Interestingly non-quiz takers were performing very much in line with the whole cohort prior to the introduction of online support.

The impact on performance was also seen in terms of performance on other first year modules - with the impact in one module actually exceeding that in the module in which the quizzes were based (see Table 21). This impact persisted throughout the students' studies so that 65.7% of quiz takers graduated on time whereas only 45.6% of non-quiz takers did so. The difference was even more marked when one considered the proportion graduating on time with a 2:1 or better: one in three quiz takers as against one in seven non-quiz takers (see Table 25 and Chart 11). This startling

finding was achieved despite the fact that when looked at in terms of “A” level entry qualifications there was no difference between the quiz takers and non-quiz takers (see Tables 9 and 10).

Further Research

This research establishes a very strong link between quiz taking and performance. However, it only demonstrates the impact of quiz taking in one undergraduate law module in one degree programme. The question remains as to whether it could be replicated on other courses and in other disciplines or put another way whether it has external validity. “*External validity* asks the question of *generalizability*: To what populations, settings, treatment variables can the effect be generalized?” (Campbell & Stanley, 1963: 175). As Kratwohl asserts “The heart of external validity is replicability.” (1985: 123).

As, Schofield concludes “the worth of a summative evaluation is greatly enhanced to the extent it can inform program and policy decisions relating to other sites.” (1993: 203) For me this relates back to the literature review of e-learning explored earlier. Whilst many writers see ICT as a solution, there is a paucity of data as to what works and in what circumstances it will and will not work. Cliff Allan’s call that there is a need to “carry forward strategies based on evidence of what works” (HEFCE, 2005a: 1) is made much more difficult because of the absence of data as to what does and what does not work. It is seventeen years since the Dearing Report identified e-learning as an answer to widening participation and worsening SSRs (NCIHE,1997:

especially para. 13.2). However, despite many guides having been produced on e-learning in the last ten years there has been little attempt to address the questions posed by Coates & Humphreys: “How intensively will students utilize online course materials? Does access to online course materials increase student comprehension and retention? (2001: 133)

Hopefully this research will help in starting to address these questions. Its structure provides a model which can be easily replicated. Modern VLEs provide easy means of monitoring student engagement with online materials. Thus, providing that in other ways the course remains unchanged, the impact of online quizzes can be readily tested. In this way what Smith described as “the goal of science” namely the ability “to generalize findings to diverse populations and times” (1975: 88) can hopefully be achieved. Certainly the model adopted for this research is one which can readily be replicated and from this it can be seen whether the findings have external validity. Further research should be undertaken as this research suggests online quiz taking improves retention, progression and performance for all students, particularly non-traditional entrants.

The research also raises further questions. The original research simply set out to assess whether online quiz taking would have a positive impact on student performance. It did not aim to quantify that impact. In fact the foregoing analysis does identify in percentage terms the extent to which quiz takers outperformed non-quiz takers in the module, in other first year modules and in terms of their position after three years of study. It also

provides data which can easily be utilised to measure the size of the effect of quiz taking on student performance. It is also apparent that there may be a number of factors at work affecting student performance. HEFCE identified A-level points as “the single most important factor in determining the expected HE achievement” (2003: 3) but acknowledged that other factors such as gender, the type of school previously attended and the subject studied could affect final degree classification. Questions such as whether quiz taking had a greater impact on performance than for example A-level grades lay outside the original project and yet the data gathered enabled these issues to be addressed. As a result Appendix A has been included. This explores the impact of a number of potential predictors of success and assesses the impact and effect size of three potentially major factors (A-level points, seminar attendance and quiz attempts) in more detail. The finding is that all have a positive impact, but that quiz attempts have the greatest impact.

As stated the original research project simply aimed to identify whether online quiz taking had a positive impact on achievement. It did not aim to identify the reason for that positive impact. There are a number of reasons why it might. Students may be benefiting from the feedback which is otherwise often lacking in modern day higher education (Bone, 2006; Clegg, 2004; Orsmond et.al, 2002). The result could be connected with immediacy of the feedback. It may be, as Driscoll (2001) suggests, that actively engaging the learner increases learning. It may simply be as Bone (2006) reported that students feel that feedback early in the course boosts

confidence and understanding. However, the findings in Appendix A suggest that it may be more than simply a relationship between quiz taking and engagement. The finding that quiz taking has a greater effect on student performance than seminar attendance raises questions as to whether there is a further more complex explanation possibly relating to the power of such online tests to foster self belief, an area explored briefly at the conclusion to Appendix A.

Just as the research raises questions as to whether it can be replicated, it also raises questions as to why it works. Much more research is needed, including qualitative research to find out more about why some students engage with online materials and why others do not and assuming the success of online quizzes can be replicated to increase our understanding of how they work. For the moment it remains work in progress, but the clear message is that online quizzes can have a very significant impact on student performance in both the short and the long-term.

Appendix A Identifying Success Predictors

The aims of the original research project were to discover:

- whether the apparent positive impact of online guidance in 2001-02 was maintained,
- to assess what proportion of students engaged with the online quizzes,
- to assess the extent to which those students who engaged with online quizzes were typical of the student cohort as a whole in terms of such variables as age, gender, prior academic qualifications, prior study of law and nationality,
- to assess whether those who engaged with the online quizzes performed better or worse in the module than those who did not engage with the quizzes,
- to assess whether those who engaged with the online quizzes performed better or worse than other students in other first year law modules, and
- to assess whether those who engaged with the online quizzes performed better or worse than other students in terms of final degree classification.

In examining these questions it became apparent that those who engaged with the online quizzes performed better than those who did not. A question which emerged during the course of the project was the extent to which quiz taking as against other factors was a predictor for success. This question lay beyond the original project and was therefore not considered in the main body. However, in gathering and analysing the data it became

possible to identify apparent linkages between certain factors and student performance. Tables A1 and A2 examine in some detail the performance of students in 2003-04 in the Legal Method module.

Table A1

Possible predictors of success

	Number in that part of the cohort	**Average Mark for Legal Method**	**Performance against average**
All students	201	54.7%	-
Quiz Takers	109	58.8%	+ 4.1%
Non-Quiz Takers	92	49.8%	- 4.9%
Female students	118	56.1%	+ 1.4%
Male students	83	52.7%	- 2.0%
Age 18 - 20	164	54.5%	- 0.2%
Age 21 - 29	24	53.9%	- 0.8%
Age 30+	13	57.6%	+ 2.9%
UK national	156	55.5%	+ 0.8%
Non-UK national	45	51.9%	- 2.8%
Non A -level entry	45	52.7%	- 2.0%
6 - 18 A level points	31	53.3%	- 1.4%
20 A-level points	27	51.4%	- 3.3%
22 A-level points	30	53.6%	- 1.1%
24 A-level points	26	58.3%	+ 3.6%
26 - 42 A-level points	41	58.4%	+ 3.7%
Previously studied law	44	57.2%	+ 2.5%
Attended 0 - 2 Legal Method seminars	32	49.1%	-5.6%
Attended 3 - 4 Legal Method seminars	32	49.8%	- 4.9%
Attended 5 - 6 Legal Method seminars	53	52.5%	- 2.2%
Attended 7 - 8 Legal Method seminars	84	60.0%	+5.3%

Table A2

Possible predictors of success ranked in terms of apparent positive impact on Legal Method performance in 2003-04

	Number in that part of the cohort	Average Mark for Legal Method	Performance against average	Ranking
All students	***201***	***54.7%***	-	
Attended 7 - 8 Legal Method seminars	84	60.0%	+5.3%	1
Quiz Takers	**109**	**58.8%**	**+ 4.1%**	**2**
26 - 42 A-level points	41	58.4%	+ 3.7%	3
24 A-level points	26	58.3%	+ 3.6%	4
Age 30+	13	57.6%	+ 2.9%	5
Previously studied law	44	57.2%	+ 2.5%	6
Female students	118	56.1%	+ 1.4%	7
UK national	156	55.5%	+ 0.8%	8
Age 18 - 20	164	54.5%	- 0.2%	9
Age 21 - 29	24	53.9%	- 0.8%	10
22 A-level points	30	53.6%	- 1.1%	11
6 - 18 A level points	31	53.3%	- 1.4%	12
Male students	83	52.7%	- 2.0%	13=
Non A -level entry	45	52.7%	- 2.0%	13=
Attended 5 - 6 Legal Method seminars	53	52.5%	- 2.2%	15
Non-UK national	45	51.9%	- 2.8%	16
20 A-level points	27	51.4%	- 3.3%	17
Non-Quiz Takers	**92**	**49.8%**	**- 4.9%**	**18=**
Attended 3 - 4 Legal Method seminars	32	49.8%	- 4.9%	18=
Attended 0 - 2 Legal Method seminars	32	49.1%	-5.6%	20

The above two Tables suggest that quiz taking was more important than A-level point score in terms of student performance, but slightly less important than regular seminar attendance. This appears to lend support to the tentative conclusion in the main body that the impact of quiz taking may have been linked to engagement as it would seem that student engagement (assuming that this could be measured by seminar attendance) would seem to be linked to student performance.

Extracting the results for seminar attendance alone it can immediately be seen that there was a link between attendance and performance.

Table A3 Performance in Legal Method and seminar attendance

	Number in that part of the cohort	**Average Mark for Legal Method**	**Performance against average**	**Ranking out of 20 factors (see Tables A1 and A2 above)**
All students	***201***	***54.7%***	-	
Attended 7 - 8 Legal Method seminars	84	60.0%	+5.3%	1
Attended 5 - 6 Legal Method seminars	53	52.5%	- 2.2%	15
Attended 3 - 4 Legal Method seminars	32	49.8%	- 4.9%	18=
Attended 0 - 2 Legal Method seminars	32	49.1%	-5.6%	20

Table A3 appears to show a fairly simple relationship. In general terms, the more seminars a student attended, the better the student performed.

Extracting the figures on A-level points the position is slightly more complex.

Table A4

Performance in Legal Method and A-level grades

	Number in that part of the cohort	**Average Mark for Legal Method**	**Performance against average**	**Ranking out of 20 factors (see Tables A1 and A2 above)**
All students	***201***	***54.7%***	-	
26 - 42 A-level points	41	58.4%	+ 3.7%	3
24 A-level points	26	58.3%	+ 3.6%	4
22 A-level points	30	53.6%	- 1.1%	11
6 - 18 A level points	31	53.3%	- 1.4%	12
Non A -level entry	45	52.7%	- 2.0%	13=
20 A-level points	27	51.4%	- 3.3%	17

In general, higher A-level grades were linked to better student performance. The linkage supports the hypothesis developed in the main body of the dissertation that better qualified students could, in general, be expected to outperform less well qualified students. This reinforces the finding that quiz taking had a positive impact on performance. Quiz takers and non-quiz takers had virtually identical A-level grades and yet quiz takers significantly outperformed non-quiz takers.

The one anomaly in the apparent link between A-level grade and performance is that the 27 students with 20 A-level points on average

performed slightly less well than those with fewer A-level points and those who were non A-level entrants. The relatively small sample size may explain this anomaly. Alternatively it could possibly be explained on the basis that some of those with fewer A-level points were accepted on the basis of several factors only one of which was their A-level grades, whereas those with 20 points were probably accepted exclusively on their A-level grades. As the standard A-level offer for the Law degree at Brookes throughout this period was 22 points, it is likely that those with markedly fewer points had to demonstrate additional qualities in order to be accepted.[13]

Other information that can be gleaned from Tables A1 and A2 above includes the fact that female students outperformed male students in Legal Method by an average of 3.4%. There are a number of possible explanations for this. Female students were slightly more likely to be quiz takers[14] and on average took more quizzes than their male counterparts.[15] Female students also attended more seminars.[16] However, differential A-level grades do not seem to be the explanation as they were virtually identical for male and female students.[17]

UK nationals outperformed non-UK nationals in the Legal Method module by an average of 3.6%. This is interesting as non-UK nationals were more avid quiz takers.[18] A possible explanation for the disparity is that the Legal Method module requires high level English comprehension skills

[13] Unfortunately this cannot be easily checked as the online registration details of students at the time only recorded other qualifications for students who had not got A-level grades.
[14] 56.8% of female students attempted at least one quiz as against 50.6% of male students.
[15] Mean number of quizzes taken: female students - 4.1; male students - 2.8.
[16] Mean number of seminars attended: female students - 5.6; male students - 5.0.
[17] Male students with A-levels averaged 22.6 points as compared to female students with A-levels averaging very slightly less with 22.2 points.
[18] 68.9% of non-UK nationals attempted at least one quiz as against just 50.0% of UK nationals.

which are likely to present more of a problem for the student for whom English is not their first language.

Table A5

Performance in Legal Method and age

	Number in that part of the cohort	**Average Mark for Legal Method**	**Performance against average**	**Ranking out of 20 factors (see Tables A1 and A2 above)**
All students	***201***	***54.7%***	-	
Age 30+	13	57.6%	+ 2.9%	5
Age 18 - 20	164	54.5%	- 0.2%	9
Age 21 - 29	24	53.9%	- 0.8%	10

Students aged 30 and above in general outperformed their younger counterparts.[19] This may be explained by the fact that they were the keenest age group in terms of quiz taking;[20] however this does not explain the relatively poor performance of those aged 21 - 29 who were also in general keen quiz takers.[21] Those aged over 30 were also more likely to attend seminars.[22]

[19] However, before any general conclusions are drawn the small size of the sample of students aged 30 and above should be noted.
[20] 76.9% of students aged 30 and above attempted at least one quiz as against only 50.0% of those aged 18 - 20. Students aged 30 and above took an average of 5.2 quizzes as against an average for those aged 18 - 20 of 3.2 quizzes.
[21] 70.8% of students aged 21 - 29 attempted at least one quiz and on average they took 5.3 quizzes - fractionally more than the average of those aged 30 and above.
[22] Students aged 30 and above attended on average 6.2 seminars as against an average of 5.3 for those aged 18-20 and 5.6 for those aged 21 - 29.

The relatively poor performance of students aged 21 - 29 is in line with similar findings by the author into student performance on law courses at another university (Catley & Bilotto, 2006). Those results led to a tentative conclusion, supported by anecdotal evidence, that students in this age group may face more financial and other pressures than the other age groups.

Tables A1 to A5 above suggest that students who attended seminars more often, attempted the quizzes and had better entry qualifications generally performed better. These findings are possibly unsurprising, though the fact that seminar attendance and quiz taking seemed a better predictor of success than A-level grades does suggest that engagement is perhaps a better predictor of success than prior achievement.

Tables 22 and 23 of the main report considered the impact of quiz taking both on final degree average[23] and arguably more importantly the impact of quiz taking on whether students graduated on time and if so, with what qualification.[24] Tables A6 and A7 consider the same factors as were considered in Tables A1 and A2 in terms of final degree classification concentrating simply on the question of whether students graduated with a 2:1 or higher after three years of study. Whilst this is a less nuanced approach than that adopted in Table 23 it does allow for measurement against what many staff and students would categorise as a good degree result.

[23] See Table 22.
[24] See Table 23.

Table A6

Predictors of success and graduate performance after three years

	Number in that part of the cohort	Number graduating on time with a 2:1 or above	Percentage graduating on time with a 2:1 or above	Performance against average
All students	195	48	24.9%	
Quiz Takers	105	35	33.3%	+ 8.4%
Non-Quiz Takers	90	13	14.4%	- 10.5%
Female students	114	33	28.9%	+ 4.0%
Male students	81	15	18.5%	- 6.4%
Age 18 - 20	163	39	23.9%	- 1.0%
Age 21 - 29	22	7	31.8%	+ 6.9%
Age 30+	10	2	20.0%	- 4.9%
UK national	153	37	24.1%	- 0.8%
Non-UK national	42	11	26.2%	+ 1.3%
Non A -level entry	40	7	17.5%	- 7.4%
6 - 18 A level points	31	7	22.6%	- 2.3%
20 A-level points	27	5	18.5%	- 6.4%
22 A-level points	30	5	16.7%	- 8.2%
24 A-level points	26	8	30.7%	+ 5.8%
26 - 42 A-level points	41	16	39.0%	+ 14.1%
Previously studied law	44	9	20.5%	- 4.4%
Attended 0 - 2 Legal Method seminars	30	2	6.7%	- 18.2%
Attended 3 - 4 Legal Method seminars	31	3	9.7%	- 15.2%
Attended 5 - 6 Legal Method seminars	52	13	25.0%	+ 0.1%
Attended 7 - 8 Legal Method seminars	82	30	36.6%	+ 11.7%

Table A7

Predictors of success ranked in terms of apparent positive impact on graduate performance after three years

	Number in that part of the cohort	Number graduating on time with a 2:1 or above	Percentage graduating on time with a 2:1 or above	Performance against average	Ranking for Legal Method	Ranking In terms of graduating with a 2:1 or above
All students	195	48	24.9%			
26 - 42 A-level points	41	16	39.0%	+ 14.1%	3	1
Attended 7 - 8 seminars*	82	30	36.6%	+ 11.7%	1	2
Quiz Takers	105	35	33.3%	+ 8.4%	2	3
Age 21 - 29	22	7	31.8%	+ 6.9%	10	4
24 A-level points	26	8	30.7%	+ 5.8%	4	5
Female students	114	33	28.9%	+ 4.0%	7	6
Non-UK national	42	11	26.2%	+ 1.3%	16	7
Attended 5 - 6 seminars*	52	13	25.0%	+ 0.1%	15	8
UK national	153	37	24.1%	- 0.8%	8	9
Age 18 - 20	163	39	23.9%	- 1.0%	9	10
6 - 18 A level points	31	7	22.6%	- 2.3%	12	11
Previously studied law	44	9	20.5%	- 4.4%	6	12
Age 30+	10	2	20.0%	- 4.9%	5	13
20 A-level points	27	5	18.5%	- 6.4%	17	14=
Male students	81	15	18.5%	- 6.4%	13=	14=
Non A -level entry	40	7	17.5%	- 7.4%	13=	16
22 A-level points	30	5	16.7%	- 8.2%	11	17
Non-Quiz Takers	90	13	14.4%	- 10.5%	18=	18
Attended 3 - 4 seminars*	31	3	9.7%	- 15.2%	18=	19
Attended 0 - 2 seminars*	30	2	6.7%	- 18.2%	20	20

* Seminar attendance relates to the number of Legal Method seminars attended.

Interestingly student engagement in terms of seminar attendance in Legal Method remained a major predictor of subsequent performance. Not only did, as discussed in the main report,[25] one third of quiz takers graduate with a 2:1 or better[26] as against only one seventh of non-quiz takers, but there was also a link between seminar attendance and degree classification.

Table A8

Degree classification after three years of study and seminar attendance in

Legal Method

	Number in that part of the cohort	**Number graduating on time with a 2:1 or above**	**Percentage graduating on time with a 2:1 or above**	**Performance against average**	**Ranking for Legal Method**	**Ranking In terms of graduating with a 2:1 or above**
All students	195	48	24.9%			
Attended 7 - 8 seminars	82	30	36.6%	+ 11.7%	1	2
Attended 5 - 6 seminars	52	13	25.0%	+ 0.1%	15	8
Attended 3 - 4 seminars	31	3	9.7%	- 15.2%	18=	19
Attended 0 - 2 seminars	30	2	6.7%	- 18.2%	20	20

More than one student in three who attended 7 or 8 seminars out of 8 in Legal Method went on to graduate with a 2:1 after three years of study as against only one student in 15 of those who had attended 0 - 2 Legal Method seminars. Indeed poor Legal Method seminar attendance was the single

[25] See Table 25 and Chart 11 in the main report.
[26] In fact no student from the September 2003 intake graduated with a first class honours degree in June 2006. Therefore all the 2:1 and above results are actually 2:1s.

greatest predictor of future poor degree performance. The findings are interesting and would seem to support the tentative conclusion in the main report that student engagement is a pivotal factor in student success. However, whilst it might be anticipated that those who were engaged with Legal Method remained engaged not only throughout their first year[27] but throughout their studies, there is no evidence to support this contention. As seminar attendance was not charted in other modules and as online quizzes were not incorporated in other modules it is not possible to identify whether, as surmised, these students remained more engaged. Another possible explanation is that quiz taking and seminar attendance in Legal Method gave students the good grounding that they required for their future studies. This interpretation supports the view that Legal Method provides the foundations on which future legal studies were built.

Looking at Legal Method performance both quiz taking and excellent seminar attendance were most closely linked to the best performance. However, when it came to degree result after three years (as shown in Tables A6 and A7 above), it was those students with the very highest A-level entry qualifications who were performing best - with 39% of these students already having graduated with a 2:1.

[27] As apparently evidenced by Table 20 in the main report.

Table A9

Degree classification after three years of study and A-level grades

	Number in that part of the cohort	Number graduating on time with a 2:1 or above	Percentage graduating on time with a 2:1 or above	Performance against average	Ranking for Legal Method	Ranking In terms of graduating with a 2:1 or above
All students	195	48	24.9%			
26 - 42 A-level points	41	16	39.0%	+ 14.1%	3	1
24 A-level points	26	8	30.7%	+ 5.8%	4	5
6 - 18 A level points	31	7	22.6%	- 2.3%	12	11
20 A-level points	27	5	18.5%	- 6.4%	17	14=
Non A -level entry	40	7	17.5%	- 7.4%	13=	16
22 A-level points	30	5	16.7%	- 8.2%	11	17

Table A9 demonstrates that in general those with higher A-level points achieved better results after three years. However, the picture as shown above is not simple or clear cut. Those with 24 A-level points and above performed better than the others, as might have been predicted. However, below that the picture was confused - with those with 22 points performing least well and those with 20 points performing less well than those with less than 20 points. There is no obvious explanation of these findings and they may simply be down to relatively small sample sizes. The possible conclusion that A-level grades are not a predictor of success over a three year degree programme does not explain why those with the best A-level grades did best.

Bringing seminar attendance into the equation does not provide an easy explanation.

Table A10

Legal Method seminar attendance and A-level grades

	Number of students	Average number of Legal Method seminars attended
Non A -level entry	40	5.8
6 - 18 A level points	31	4.9
20 A-level points	27	4.5
22 A-level points	30	5.6
24 A-level points	26	5.8
26 - 42 A-level points	41	5.4

Table A10 also shows that those with better A-level grades generally attended more seminars than those with poorer A-level grades. This would seem to reflect the general outcome in both Legal Method and after three years study where overall those with better A-level grades did better. The performance of those A-level entrants with 20 A-level points and below supports this link. These were the groups with the lowest A-level points and also the poorest rate of seminar attendance. They also achieved a below average level of performance in both Legal Method and after three years. The performance of those with 24 A-level points and above similarly supports the thesis that there is a connection between A-level grades, seminar attendance and performance both after one term and after three years. These students attended more Legal Method seminars than those A-level entrants with 20 points and below, had better A-levels and gained better grades throughout their studies. However, those with 22 A-level points had almost the highest

rate of Legal Method seminar attendance but the worst results after three years. Clearly more research needs to be undertaken if a robust explanation is to be discerned.

In examining degree performance after three years study it can be seen from Tables A6 and A7 that female students outperformed male students with 28.9% of female students graduating with a 2:1 after three years as against only 18.5% of male students. As examined earlier the female students had virtually identical A-level scores as the male students,[28] so the explanation is more likely to relate to engagement - evidenced by their better seminar attendance and their greater willingness to engage with the quizzes. The finding runs counter to the HEFCE (2003) finding that male undergraduates very slightly outperformed female undergraduates with the same A-level entry qualifications. The HEFCE study was just looking at 18 year old degree entrants whereas this analysis is based on entrants of all ages and this may explain the disparity. Additionally the HEFCE study was based on university entrants in 1997-98, whereas this research project was focussing on entrants in 2003-04 - possibly in the intervening years there had been changes either within the education system or outside to affect the relationship. Finally and possibly most significantly as noted by HEFCE (2005b) there are differences in the subjects studied by male and female undergraduates, with a greater preponderance of male students in the sciences where traditionally more firsts have tended to be awarded. The HEFCE (2003) report looks at performance in higher education generally

[28] Male students with A-levels averaged 22.6 points as compared to female students with A-levels averaging very slightly less with 22.2 points.

whereas this research project was simply looking at performance in one discipline at one university.

Interestingly those who had studied Law A-level or AS-level performed better than average in Legal Method, but performed below par after three years of study. In Legal Method this group achieved an average of 57.2% as against a cohort average of 54.7% (see Tables A1 and A2). However, when it came to graduating within three years with a 2:1 or better only 20.5% of those who had previously studied Law at A or AS-level achieved a 2:1 as against a cohort average of 24.9%. A possible explanation is that prior study of law was a considerable advantage in first year law modules. However, as students got further into the course those who had previously studied Law were increasingly studying unfamiliar topics and their advantage was disappearing. This might explain a reduction in their advantage, but does not explain why they eventually performed less well. Another possible explanation is that after the first year they felt that they did not need to work as hard in order to succeed - an approach which turned out to be based on a false confidence. However, there is no evidence to either support or challenge this theory. The evidence from Legal Method is that those who had passed A-level law attended the same number of seminars on average as those who had not previously studied law[29] suggesting an equivalent level of engagement. However, whether this level of engagement was maintained is unknown.

An interesting finding in terms of quiz taking was that less traditional students in terms of age, nationality and entry qualifications were more likely to take quizzes. When looking at performance in Legal Method these groups

[29] Those with A-level law attended on average 5.2 seminars out of 8 in Legal Method. The figure for those who had clearly not studied law prior to university was virtually identical at 5.3 seminars.

with the exception of those students aged 30 and above generally performed less well.[30] In looking at performance after three years the picture is interestingly different.

Non-UK nationals proved slightly more likely to graduate with a 2:1 within three years - 26.2% as against 24.1% of UK nationals. Whilst the closeness of the result and the small sample size of the non-UK national group makes it dangerous to generalise from this finding,[31] it is noteworthy that the non-UK nationals were no longer after three years performing less well. Therefore possibly the increased engagement evidenced by a greater willingness to engage with the quizzes could possibly explain their improved performance, alternatively the explanation may simply relate to improved language skills acquired during three years of undergraduate study.

The increased engagement leading to better performance explanation does not apply to non A-level entrants. These students continued to perform less well than average after three years.[32] The point can be made that with a small sample only a few changed results would alter the picture - for example had three more non A-level entrants gained a 2:1 rather than a 2:2 the percentage gaining a 2:1 within three years would have equated to the cohort average. Nevertheless it seems that in general non A-level entrants, despite being more prepared than the average to attempt the online quizzes, did less well. If success is simply linked to engagement, the comparatively poor performance of non A-level entrants is surprising. In Legal Method these

[30] See Tables A1 and A2 generally. See Table A4 for performance in terms of entry qualifications and see Table A5 for performance by age grouping. See also the general discussion on performance in Legal Method on pages v to viii.
[31] If one non-UK national had graduated with a 2:2 rather than a 2:1 the percentage of non-UK nationals graduating with a 2:1 would have dropped to 23.8%. A figure 0.3% below the average for UK nationals.
[32] See Table A9 above.

students were more prepared to attempt the quizzes[33] and as shown in Table A10 above they attended more Legal Method seminars than those who had entered on the basis of A-level results. Generally this research has identified quiz taking and Legal Method seminar attendance as being positively associated with performance after three years.[34] However, non A-level entrants were generally still performing less well than average after three years. There is no obvious explanation arising from the data gathered. Various theories could be postulated. Perhaps these students start with a disadvantage which they are never able to overcome. Perhaps they have more external pressures that prevent them being able to focus on their studies. Answers to these questions deserve further examination but lie outside the remit of this research project.

In terms of age, then in relation to Legal Method the picture had been slightly confused with students aged over 30 performing better than average but those aged 21-29 performing less well than average. However three years later the picture was reversed.

[33] 63.6% of non-A-level entrants were quiz takers as against 51.6% of A-level entrants.
[34] See Tables A6 and A7 above.

Table A11

Degree classification after three years of study and age grouping

	Number in that part of the cohort	Number graduating on time with a 2:1 or above	Percentage graduating on time with a 2:1 or above	Performance against average	Ranking for Legal Method	Ranking In terms of graduating with a 2:1 or above
All students	195	48	24.9%			
Age 21 - 29	22	7	31.8%	+ 6.9%	10	4
Age 18 - 20	163	39	23.9%	- 1.0%	9	10
Age 30+	10	2	20.0%	- 4.9%	5	13

Those aged 21 - 29 had after three years become the best performing age grouping with 31.8% gaining a 2:1 within that timeframe. Conversely those aged 30 and above were the least likely to gain a 2:1 within three years, despite having been the best performing age group in Legal Method and the age group most likely to engage with quizzes and attend seminars.[35] Again sample size raises a major caveat; if one more student aged 30 and above had gained a 2:1 rather than a 2:2 within the three year period then the performance of the age grouping would have exceeded the average.

One means of coping with the small sample size when breaking the cohort up into a number of sub-groupings is to examine the entire cohort in terms of a number of measures applicable to them all (or at least substantially all of them). Three factors that appear linked to student performance are quiz

[35] Those aged 30 and above attended an average of 6.2 seminars in Legal Method. Those aged 21 - 29 attended 5.6 seminars and those aged 18 - 20 attended an average of 5.3 seminars.

taking, seminar attendance and A-level grades. There are 157 students[36] on which there is data on all three criteria.

Performance in Legal Method reconsidered

Table A12 Descriptive Statistics

	Mean	Std. Deviation	N
Marks in Legal Method	55.1592	12.92905	157
A-level Points	22.37	5.874	157
Seminars attended in Legal Method	5.2484	2.51574	157
Quizzes attempted in Legal Method	3.3376	3.86064	157

Table A12 shows the mean and standard deviation for each of the four variables being considered.

[36] The 44 students who gained entry without A-levels have been excluded from this part of the analysis.

Table A13 Correlations

		Marks in Legal Method	A-level Points	Seminars attended in Legal Method	Quizzes attempted in Legal Method
Pearson Correlation	Marks in Legal Method		.161	.331	.372
	A-level Points			.122	-.017
	Seminars attended in Legal Method				.278
Sig. (1-tailed)	Marks in Legal Method		.022	.000	.000
	A-level Points			.064	.414
	Seminars attended in Legal Method				.000

Table A13 above shows the correlation between the variables. None of the predictors correlate too highly with each other, r > .9 (Field, 2005: 186).[37] The relationship between all three variables when measured against performance in Legal Method is significant. The significance of A-level points is only .022, meaning that there is just over a 2% possibility that the relationship has arisen by chance. On the other hand, the significance of the relationship between Legal Method marks and both seminar attendance and

[37] If two variables correlated very closely (for example if quiz taking was very closely linked to seminar attendance) it would make it difficult to assess whether both were having an effect on student performance or whether only one of them was having that effect and if so which one.

quiz attempts is less than .001. This means that there is less than one chance in a thousand of the null hypothesis i.e. that there is no relationship between either quiz taking or seminar attendance and performance in Legal Method.

The Pearson Correlation Coefficient for the marks in Legal Method is interestingly higher for both seminar attendance and for quiz taking than they are for A-level points. This supports the contention that these factors are a greater predictor of success than A-level grades. This is particularly noteworthy in the light of the HEFCE (2003) finding that A-level grades of 18 year old university entrants are the most important pre-university predictor of higher education achievement. In relation to Legal Method performance the Pearson Correlation Coefficient for quiz taking is higher than that for seminars suggesting a closer link between quiz taking and performance than there is between seminar attendance and performance.

Table A14 Model Summary[b]

Model		1
R		.462[a]
R Square		.214
Adjusted R Square		.198
Std. Error of the Estimate		11.57709
Change Statistics	R Square Change	.214
	F Change	13.854
	df1	3
	df2	153
	Sig. F Change	.000
Durbin-Watson		1.90[38]

[a] Predictors: (Constant), Quizzes attempted in Legal Method, A-level Points, Seminars attended in Legal Method

[b] Dependent Variable: Marks in Legal Method

The r^2 figure of .214 indicates that the three variables (A-level points, quiz taking and seminar attendance) are capable of predicting 21.4% of the marks in Legal Method.

[38] The closeness of the Durbin-Watson statistic to 2 indicates that the errors in regression are independent. A result of less than 1 or greater than 3 would have called for further investigation (Field, 2005: 190).

Table A15 ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5570.596	3	1856.865	13.854	.000[a]
	Residual	20506.423	153	134.029		
	Total	26077.019	156			

[a] Predictors: (Constant), Quizzes attempted in Legal Method A-level Points, Seminars attended in Legal Method

[b] Dependent Variable: Marks in Legal Method

Table A16.1

Coefficients[a]

Model		Unstandardized coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	38.723	3.976		9.738	.000
	A-level Points	.305	.159	.138	1.913	.058
	Seminars attended	1.170	.387	.228	3.023	.003
	Quizzes attempted	1.043	.250	.312	4.169	.000

[a] Dependent Variable: Marks in Legal Method

Results in the Sig column of less than .05 are significant, results of less than .005 are very significant. Both the figure for seminars attempted and for quizzes attempted are very significant. The figure for quizzes attempted being less than .001. The standardized beta values indicate the importance of each predictor. As with the sig results these indicate that the number of quizzes attempted was the most important factor, followed by the number of seminars attended. The A-level points achieved prior to the start of the course have a much lower standardized beta value and fall just outside the .05 significance threshold.

Table A16.2

Coefficients[a]

Model		95% Confidence Interval for B	
		Lower Bound	Upper Bound
1	(Constant)	30.868	46.579
	A-level Points	-.010	.619
	Seminars attended	.405	1.934
	Quizzes attempted	.549	1.538

All values within the 95% confidence interval for both seminars attended and quizzes attempted are positive, reinforcing the message that attending seminars and attempting quizzes leads to better results. Whilst most values for A-level points are positive the lower bound of the 95% confidence interval is negative raising a slight question as to whether better A-level grades are necessarily a predictor of Legal Method success.

Table A16.3

Coefficients[a]

Model		Correlations			Collinearity Statistics	
		Zero-order	Partial	Part	Tolerance	VIF[39]
1	(Constant)					
	A-level Points	.161	.153	.137	.982	1.018
	Seminars attended	.331	.237	.217	.907	1.103
	Quizzes attempted	.372	.319	.299	.920	1.087

[a] Dependent Variable: Marks in Legal Method

The figures for partial correlation indicate the extent to which performance can be attributed to that particular variable. The square of the partial correlation indicates the percentage of the marks that can be attributed to that variable.

[39] The average VIF is very close to 1 and the tolerance figures are well above .2. This confirms that there is not a problem with collinearity. If the largest VIF had been greater than 10 then there would be a cause for concern (Myers, 1990; Bowerman & O'Connell, 1990). If the average VIF had been substantially greater than 1 then the regression may be biased (Bowerman & O'Connell, 1990). Tolerance below .1 indicates a serious problem (Field, 2005). Tolerance below .2 indicates a potential problem (Menard, 1995).

Table A 16.4

Partial Correlation^2

	Partial Correlation^2
A-level Points	.019
Seminars attended	.056
Quizzes attempted	.102

Table A 16.4 indicates that 10.2% of the Legal Method results could be attributed solely to quiz attempts. This compares to 5.6% of the result being capable of being explained by seminar attendance and 1.9% being attributable to A-level grades.[40] This is in line with the earlier findings indicating that quiz attempts had the most impact on student performance, with seminar attendance the second most influential factor and A-level grades the third most influential. However, the finding is quite dramatic in that it indicates that quiz attempts are almost twice as important an influence as seminar attendance and more than five times as important as A-level points as a predictor of success.

[40] The total of these three effect sizes (10.2% + 5.6% + 1.9% = 17.7%) does not equate to the 21.4% calculated earlier as being the influence of the three factors combined. The difference is explained by the fact that there is some overlap between the three factors where two or more factors are working together to affect the marks. The calculation in the above Table seeks to isolate the effect of each variable and in so doing avoids the uncertainty as to which variable is having the impact where there is an overlap.

Table A17

Casewise Diagnostics[a]

Case Number	Std. Residual	Marks in Legal Method	Predicted Value	Residual
40	-3.023	31.00	66.0013	-35.00132

[a] Dependent Variable: Marks in Legal Method

Table A17 identifies only one student with a mark which is very different from that which would be predicted given the student's A-level grades, seminar attendance and record of quiz attempts. Field (2005) suggests that a check should be made if more that 5% of cases have values above 2. Only one out of 157 (0.6%) falls outside + or - 2. This is also within Field's suggestion that results should be investigated further if more than 1% fall outside + or - 2.5. As the one case is outside = or - 3, it can be viewed as an outlier.[41]

[41] Whilst it is viewed as acceptable to exclude occasional outliers from an analysis, the analysis was not re-run excluding this one case. As there was only one outlier out of 157 records being examined the impact of excluding this one case was not expected to alter the clear picture that had emerged.

Chart A1

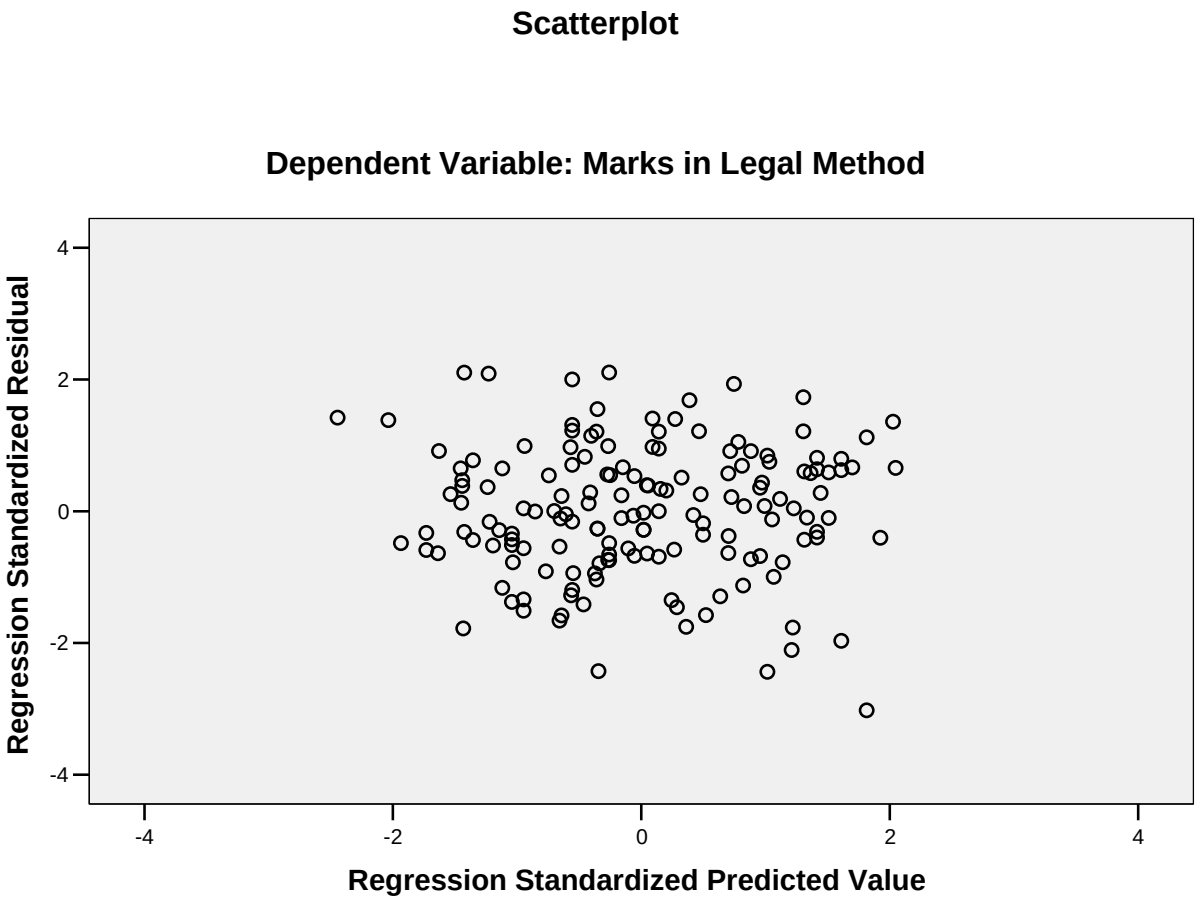


Chart A1 shows an even dispersal of points throughout the plot. This indicates that the assumptions of linearity and homoscedasticity have been met. In other words it demonstrates, as has already been shown in the preceding tables, that the results did not violate the assumptions that A-level points, seminar attendance and quiz attempts would all have a positive effect on student performance in the Legal Method module.

The above statistical analysis has shown that both quiz taking and seminar attendance led to better marks in Legal Method. This was also almost certainly true of A-level grades. Overall the three factors were shown

to be able to predict over 21% of the marks awarded in the module.[42] The Beta standardized coefficient results[43] indicate that for each quiz attempted students could be expected to improve their mark by 0.312 marks. This compared to an average improvement of 0.228 for every seminar attended and 0.138 for every additional A-level point the student had achieved. When an attempt was made to separate the impact of each predictor[44] it was found that quiz attempts were a much better predictor of success than either seminar attendance or A-level points - with 10.2% of the results being solely attributable to quiz attempts, 5.6% attributable to seminar attendance and 1.9% to A-level grades.

Whilst providing very strong evidence for the beneficial impact of the online quizzes, these findings also raise some questions. In the main body a hypothesis was developed that quiz taking encouraged engagement with the course and that this was the reason why quiz takers performed better than non-quiz takers. Such a hypothesis would be likely to lead to an expectation that a similar level of improvement would be exhibited in relation to seminar attendance. However, whilst seminar attendance was shown to be beneficial, the extent of the positive impact of seminar attendance was not as great. This discrepancy might possibly be explained by the particular nature of the quizzes and seminars on this particular course. Attempts to replicate this project in other modules, at other universities and in other subject areas might help discover whether there was something about this particular module and the nature of the quizzes and seminars which led to the results.

[42] See Table A14 above.
[43] See Table A16.1 above.
[44] See Table A16.4 above.

Nevertheless the possibility exists that there is something about quiz taking that goes beyond simply fostering engagement. The ability to undertake work at a time of the student's choosing; to repeat the work whenever the student wants to do so and the ability to receive immediate feedback tailored to the answers the student has given may mean that online quizzes have strengths which seminars cannot replicate.

This is clearly an area for further research. As a tentative suggestion it may be that online quiz taking fosters self belief, linking into the idea that people's motivation and success is influenced by their belief in their own ability to organise and carry out the necessary actions (see for example: Bandura, 1997; Pajares & Schunk, 2001; Pintrich & De Groot, 1990).

Appendix B

Postscript

In 2004-05 there were major changes to the undergraduate degree structure at Oxford Brookes University. The term based modular course structure was replaced by a semester based system. Legal Method remained a 15 credit level 1 module and continued to be completed before Christmas. However, instead of being typically studied alongside two other modules it was, as from September 2004, generally studied simultaneously with three other modules. The course length was also changed. Instead of running for eight teaching weeks, followed by a revision week and then an examination week, the structure was changed. An earlier September start enabled the module to be run over 12 weeks. The number of lectures was increased by one, a reading week was introduced and the coursework submission date was delayed by one week. As discussed in the main body this meant that it was not realistic to include the experience of students studying Legal Method in 2004 in the assessment of the impact of the online quizzes.

However, there are some interesting points to be gleaned from the 2004-05 cohort. By the time this group took the module, preliminary assessment of the performance of quiz takers and non-quiz takers had been undertaken (Catley, 2005). As it had already been decided to exclude these students from the research project it was decided that they should be told the findings of this research; this was covered in the extra lecture. This additional lecture was delivered early in the module.

118 of the 152 students on the module (77.6%) attempted at least one quiz.

Table B1

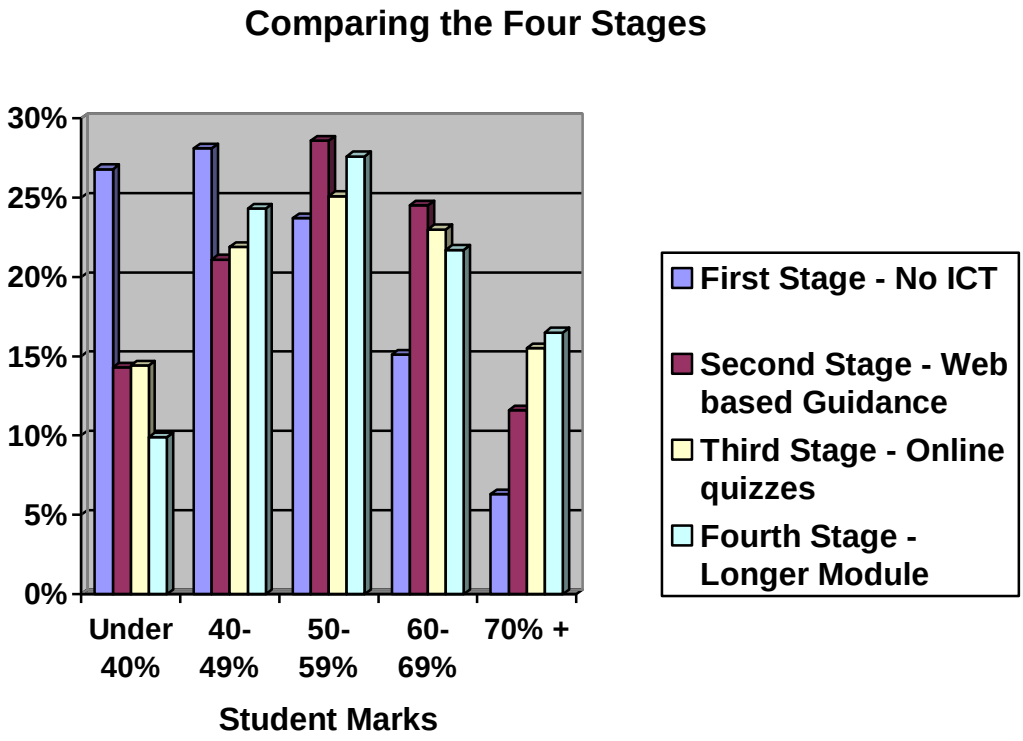
Number of quizzes attempted

	2003-04 cohort		2004-05 cohort	
Number of quizzes attempted	Number of students	Percentage of cohort	Number of students	Percentage of cohort
None	92	45.8%	34	22.4%
One	7	3.5%	6	3.9%
Two	12	6.0%	8	5.3%
Three	7	3.5%	5	3.3%
Four	4	2.0%	4	2.6%
Five	5	2.5%	6	3.9%
Six	9	4.5%	5	3.3%
Seven	4	2.0%	7	4.6%
Eight	6	3.0%	6	3.9%
Nine	55	27.4%	71	46.7%
	201		152	

The above Table suggests that students were more prepared to engage with the quizzes when they were provided with evidence as to the advantages of quiz taking. Nevertheless despite the strength of the findings

almost a quarter of the cohort did not attempt any of the quizzes and less than half attempted all of them.

Chart B1



The above Chart shows that the improved results continued after the major changes that took place in 2004-05. The percentage of firsts rose to 16.5% from 15.5% the previous year and a start point of just 6.3%. The percentage of marks of 60% and above was very close to that in 2003-04 with 38.2% achieving such marks in 2004-05 as against 38.8% a year earlier. Both figures were a very marked improvement on the 21.4% achieved before online support. In terms of fails the 2004-05 results were the best achieved in any year - with only 9.9% failing at first attempt. The range of factors that changed in 2004-05 makes it virtually impossible to

identify cause and effect. However, an analysis of the performance of quiz takers against non-quiz takers supports the conclusion in the main body of the thesis and in Appendix A that quiz takers outperform non-quiz takers.

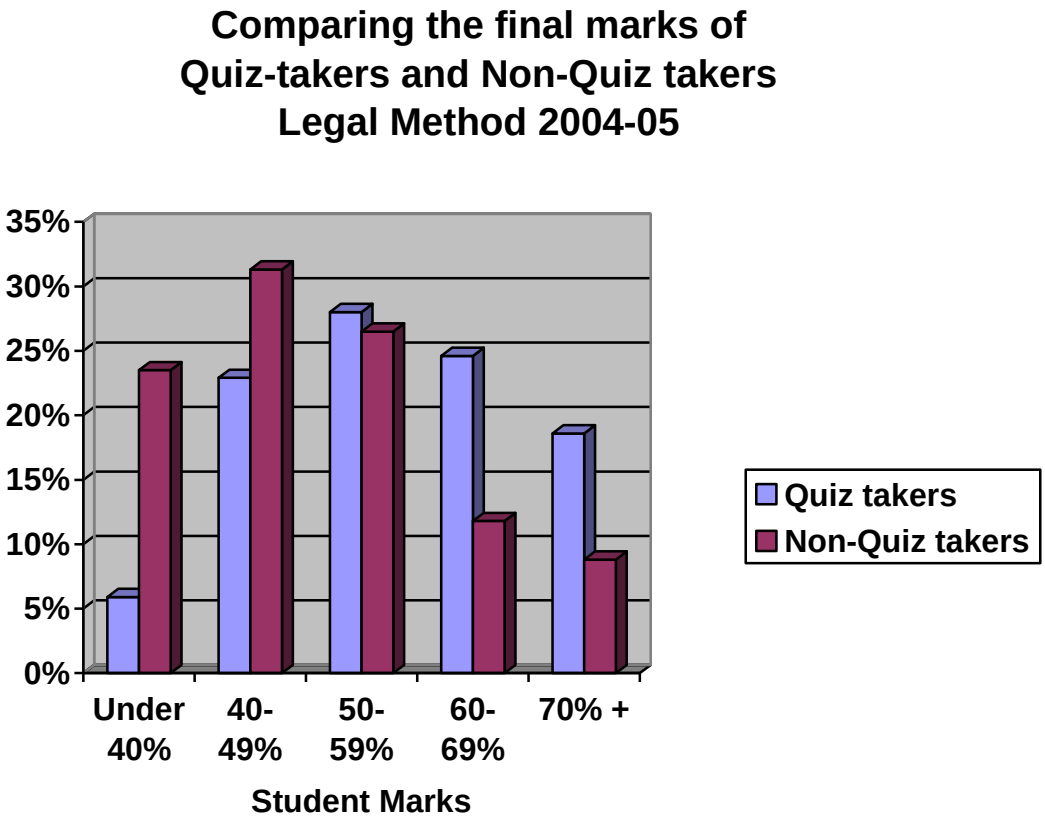
Table B2

Comparing the Marks in Legal Method of Quiz Takers and Non-Quiz Takers

	Quiz Takers 2004-05		Non-Quiz Takers 2004-05	
Mark Grouping	Number of students	Percentage of cohort in each mark grouping	Number of students	Percentage of cohort in each mark grouping
70% +	22	18.6%	3	8.8%
60 - 69%	29	24.6%	4	11.8%
50 - 59%	33	28.0%	9	26.5%
40 - 49%	27	22.9%	10	31.3%
Under 40%	7	5.9%	8	23.5%
Size of cohort	118		34	

Quiz takers were more than twice as likely to gain marks of 70% and above. 43.2% of quiz takers gained marks of 60% and above as against just 20.6% of non-quiz takers. Whilst quiz taking did not eliminate the risk of failure, the percentage failing was only about a quarter that found among non-quiz takers: 5.9% as against 23.5%. These differences are also shown in Chart B2 below.

Chart B2



Overall the results of the 2004-05 cohort supported the earlier conclusions. Quiz taking was linked to better student performance. Table B3 shows the statistical link between quiz taking and student performance.

Table B3

Correlation - Quiz Attempts and Legal Method Marks

		Marks for Legal Method
Quizzes attempted	Pearson Correlation	.400(**)
	Sig. (1-tailed)[45]	.000
	N	152

** Correlation is significant at the 0.01 level (1-tailed).

The finding of a Pearson Correlation Coefficient (r) of .400** means that given the sample size there was a less than one percent probability that the relationship between quizzes attempted and marks was simply a chance relationship. This exceeds the .342** Pearson Correlation Coefficient found when analysing the 2003-04 cohort as shown in Table 22 of the main body. The r^2 figure suggests that 16% of the results could be predicted by the number of quiz attempts.

As discussed in the main body, this research project has identified a very strong link between quiz taking and student performance in one law module in one undergraduate programme. The link has been repeated over three separate cohorts and in the one year in which it has been followed through it has also been shown in other first year law modules and in degree performance after three years. A range of issues remain to be tested for example whether these results can be replicated in other subject areas and

[1] A one-tailed test of significance has been used because it is anticipated that quiz taking will have a positive impact on performance. A two-tailed test of significance would have been used if it had been anticipated that quiz taking would affect performance, but the direction of that impact was unknown (i.e. it was thought quiz taking would affect performance, but there was no certainty as to whether it would improve or worsen performance).

in other universities. However, the 2004-05 cohort results suggest that the take up of online quizzes can be improved and that by explaining to students the benefits of quiz taking those positive benefits can be increased further.

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